The Electrical World.

VOL. XXXIII. NEW YORK, JANUARY 21, 1899. No. 8.

PUBLISHED EVERY SATURDAY BY

THE W. J. JOHNSTON COMPANY,

9 Murray Street, New York.

Telephone Call: Cortlandt 924. Cable Address: "Electrical," New York.

New England Office, 620 Atlantic Ave., Boston.
Western Office, 936 Monadnock Block, Chicago.
Philadelphia Office, 929 Chestnut Street.

SUBSCRIPTION IN ADVANCE, ONE YEAR, $3.00,

in the United States, Canada or Mexico; other foreign countries, $6.00.

In requesting your address changed give OLD as well as new address.

Now in its third decade, THE ELECTRICAL WORLD is the Pioneer Electrical Journal of America, and has well maintained its lead. It has the largest Circulation of any electrical periodical, and is the best Advertising Medium.

THE ELECTRICAL WORLD'S Advertising Rates are much lower than those of any other similar publication, circulation considered, and vary according to space, position and number of insertions. Quotations promptly furnished.

Address and make drafts, orders, etc., payable to

THE ELECTRICAL WORLD,

9 Murray Street, New York.

VOL. XXXIII. NEW YORK, JANUARY 21, 1899. No. 3.

CONTENTS.

	PAGE.
Editorial	73
The Storage Battery Substations of the Metropolitan Street Railway, New York City	75
The Delivery and Distribution of Niagara Power in Buffalo	76
Additions to the Electrical Apparatus of the Massachusetts Institute of Technology	76
Telegraphing Without Line Wires, II., by William Bissing	83
Telephone and Street Railway Systems in Shanghai	86
Digest of Current Electrical Literature, Compiled by Carl Hering	87
The Emerson Organ-Pumping Outfit	93
The Eureka Express Switchboard	93
Departments:	
Financial Intelligence	94
Special Correspondence	94
General News	97
Legal Notes	98
Personal Notes	98
Obituary Notes—Joel C. Clark—M. C. Bullock	98
Trade and Industrial Notes	98
Illustrated Record of Electrical Patents	99

THE PROTECTION OF TRANSMISSION LINES.

The utilization of Niagara power involves more transformations from one voltage, phase relation or kind of current to others than perhaps any other power-distributing system. This striking application of the flexibility of electric power, however, involves great risk, not so much of breakdown as of interruption from the unwarranted operation of the numerous circuit-opening devices needed to protect the various transforming machines. For example, it is only necessary to trace the course of the power from the machines at Niagara Falls to the premises of a customer of the Buffalo General Electric Company. It passes first through the fuse-shunted circuit breakers protecting the step-up transformers at the power station; next through similar breakers protecting the step-down station of the Cataract Power & Conduit Company; next through high-tension expulsion-type fuses protecting the primary windings of the step-down transformers; next through aluminum fuses protecting the secondary windings; then through fuses protecting the a. c. end of the rotary converters, circuit breakers in the d. c. end, circuit breakers in the outgoing feeders, and finally through fuses at the consumer's premises. It is obvious that the chance of interruption at one or another of these many points is quite large.

The effect of even a brief interruption is also comparatively serious on a system of this kind. Alternating synchronous motors, of which there are now many on this line, when loaded, will drop sufficiently below synchronism during an interruption of a very few seconds, so that on the restoration of the power they do not tend to run up again with torque sufficient to pull them into step, but act as a "beating" short circuit upon the lines. This is due to the fact that a synchronous motor must be running sufficiently close to synchronism when the current is thrown upon it to be pulled into mathematical synchronism against the load upon its shaft by the effort that the current can exert upon it during one-half a period (in case of Niagara power one-fiftieth of a second); otherwise, it will not lock in but act alternately as a motor and generator, taking from and giving to the line strong beats, and—unless it is running light—slowing down and stopping. Thus, in case of such an interruption, it is necessary to remove the load from such a machine, open its field circuit, throw it on to the starting coils, bring it up to speed, connect it across the mains, recharge its field and restore its load again before normal working is resumed, a sequence of operations taking no short time or small amount of attention, especially if there are many such motors in one station, as is the case with one of the Buffalo loads. In the case of rotary converters running in multiple with other sources of power, such as storage batteries or steam-driven generators, the interruption of the main supply causes them to feed back, tending to drive the other loads taking power from the alternating system, and unless the rotaries have a capacity equal to that of all the other loads (a highly improbable case) they are greatly overloaded, blowing out fuses and throwing out circuit breakers generally. Other loads peculiarly disturbed by interruptions are grain elevators, two of which are supplied with power from Niagara. The slowing down of the grain-hoisting legs is followed by an immediate choking up of the pits by grain spouted down, which so overloads the motors that on attempting to re-start they are stalled and require several hours' hand-work to dig out the choked buckets and belts.

For these reasons the continuity of supply on this particular system is a peculiarly serious requirement, and the perfection of the details, particularly the protective circuit breakers and fuses, a description of which will be found on other pages of this issue, is an unusually difficult problem. Following the lead of Edison low-tension central-station and railway work the poor abused fuse has been largely thrown out, except to relieve its successor, the circuit breaker, of the discharging arc. The number of automatic opening devices has also been reduced, individual fuses on the primaries and secondaries of each transformer being replaced by breakers protecting whole groups or banks of transformers, or a whole substation, etc. The ingenious scheme of a duplicate system linked together from point to point with circuit breakers, affected only by currents in one direction through the cross-connecting branches,

the whole arranged in such a way that the one of the duplicate parts on which a short circuit occurs will be opened at both ends, leaving its duplicate working free, appears at first sight to be complicated, but promises a great advance over present methods of electrical protection. Time-element circuit breakers for opening a short circuit at the nearest breaker between it and the power house and not at the others also aim at a much-needed improvement.

THE CONNECTIONS OF TRANSFORMERS ON THREE-PHASE SYSTEMS.

There are in general three different groupings by which the primary and secondary windings of transformers may be connected for stepping by means of single-phase transformers from one voltage to another without changing the phase relation. One of these is obtained by connecting to one common point one terminal of the corresponding winding of each of three transformers, the other three terminals being respectively connected to the three legs of the three-phase system. This gives—from the shape of the vector diagram of the e. m. fs. concerned—what is known as the star or Y-grouping. Another plan connects the three windings in a closed loop, the three legs being tapped into the respective junctions, giving what is known as the triangle or Δ grouping. Another, which is generally associated with the name of Charles F. Scott, its inventor, utilizes two transformers only, connecting the terminal of one into the central point of the other, giving a vector diagram in the shape of a T. While this was primarily intended and is generally used for transforming from two phases to three phases or vice versa, it is also perfectly practicable to connect both primaries and secondaries in T-groups and thus transform with only two units from three phases to three phases. At least one transforming equipment using Niagara power is so arranged.

Discussing the last system first, it should be noted that the copper loss is necessarily higher with the same sized units grouped in this than in other ways. This is owing to the fact that the currents in the two branches forming the head of the T are out of phase with the e. m. fs. impressed upon the same windings, although this departure from unity power factor does not react upon the rest of the system, since the currents lead in one branch and lag in the other, and—both branches being wound upon the same core—balance each other's wattless effect. Transforming from two phases to three phases, the copper loss of the secondary of this one of the two transformers is thus 33⅓ per cent. greater than it would be were the delivery at two phases, assuming a non-inductive load. This figure looks formidable until it is remembered that the total copper loss at full load of transformers of the sizes customary in multiphase power work amounts to between 1 and 2 per cent. of the rated output, the total secondary loss being thus less than 1 per cent., and the increase of the total loss less than one-third of 1 per cent. of the rated output of one transformer, or one-sixth of 1 per cent. of the rated output of the two. The T-connection necessitates an e. m. f. in the vertical branch of the T lower by 13 per cent. than in the horizontal branches or head of the T, the amount of energy transformed in the two branches being the same. One of the two transformers can, of course, be specially wound for this, but it is often preferable in changing from two phases to three phases or vice versa (if only one spare is available) to make the two transformers duplicates and interchangeable, and obtain the correct ratio of voltages by tapping the proper winding of one at a suitable point, leaving 13 per cent. of the turns of primary or secondary idle at the expense of an increase in the copper loss equal to one-half the increase in the head of the T.

Stepping from three phases to three phases with two T-connected transformers, the copper loss in both the primary and secondary windings of the transformer represented by the head of the T is 1.33 times what it would be with the same load carried by the same transformers working from two phases to two phases. The condition of the transformer represented by the vertical branch of the T is, however, somewhat different. If it is desired to make this a duplicate of the other, so that either can be replaced by one spare, all the copper of both primary and secondary windings can be used, in which case the maximum induction in the iron will be only 87 per cent. of that in the transformer represented by the head of the T, reducing the iron loss roughly 25 per cent., but making the copper loss of both primary and secondary one and a third times that, were the transformer wound for the same induction as its mate.

Wherever the amount of power to be transformed does not exceed the capacity of a single group of transformers of the largest commercial size, which is now about 1000 kilowatts, the above-mentioned added losses of T-connected groups may be often more than counterbalanced by the increased size of the units. The number of transformers necessary being reduced from three to two, the size of each is raised 50 per cent, with the well-known accompanying increase of efficiency and reduction at first cost, floor space occupied and complication In laying out three-phase transformer substations, the T-grouping offers an admirable method of carrying the light pioneer loads without too great cost or iron loss, and increasing the number of units in the installation by small jumps instead of large ones; for example, the first equipment could consist of two transformers connected up in the T relation, to which, as the load becomes greater than their capacity there could be added a third, the three being connected as a Δ. A further increase of load could be provided for by addding another, the four being connected in two T-groups. When the load becomes too great to be carried under emergency by three of these in Δ should one break down, a fifth can be added as a reserve; with a further increase six can be connected in two deltas, and so forth.

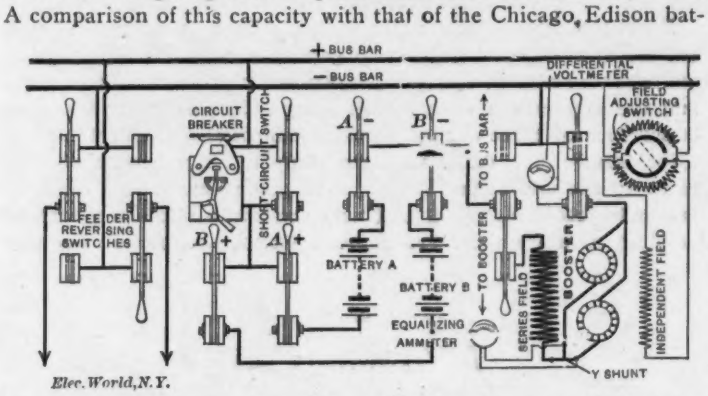
As between the two systems of connecting up groups of three transformers, respectively referred to here as the Y and the Δ. the former has the great advantage for high-tension windings that the voltage per transformer, when so connected, is only 59 per cent. of the voltage between lines, while the Δ-connection gives each transformer the full line pressure. With the Y-connection the insulation between turns can be reduced to correspond, and the cross-section of the conductor increased. For this reason it has been customary to connect up transformers with their high-tension sides in a Y, and their low-tension sides (in order to keep down the cross-section of the conductors) in a Δ. One transformer substation of the Cataract Power & Conduit Company, a description of which will be found on other pages of this issue, is so connected, although another just completed is connected entirely in Δ for reasons, some of which are as follows: With Δ-connected windings, if any one becomes crippled or open-circuited, the other two—with a vectorial relation represented by the letter V—will continue to deliver power to all three phases, although the currents through each transformer will necessarily be considerably out of phase with the impressed e. m. fs., leading by one-twelfth of a period in one transformer and lagging by the same amount in the other—assuming that the load is non-inductive. This will considerably affect the inductive drop in the transformers, increasing it in the one and rendering it negative in the other. The copper losses per transformer will also be three times as great with two working as a V than with three working as a Δ. These two disadvantages render it inadvisable to transform from three phases to three phases with two transformers connected as a V, although they may be so used temporarily in case of emergency. A motor load, either synchronous or inductive, helps to balance out the distortion of the currents in the two transformers, and thus reduces the increased heating and unbalanced drop.

With Y-connected windings the opening of any one branch throws out two phases, leaving only one phase working. This, as is well known, will carry alternating-current motors, but only by more than tripling the load on the one phase still working, and with a great unbalancing effect on the system supplying it. Hence, in this respect, the Δ-connection is superior to the Y. Transformers connected in Y on the high-tension sides and in Δ on their low-tension sides present other complications, for a complete discussion of which there is not room here. The opening of any branch of the Y interrupts the supply of current to two phases and delivers to the third only 87 per cent. of the normal voltage. The opening of any one side of the Δ causes a reaction which tends to bring the currents in the other two sides of the Δ in phase with each other, a condition strongly resisted by any motor load at the expense of all fuses and circuit breakers connected therewith. This condition can be eliminated if there are several groups of transformers in multiple with each other by cross-connecting the common points of the various Ys. Groups Y-connected in both primaries and secondaries can be paralleled on both sides with groups Δ-connected throughout, but groups Y-connected on the high-tension side and Δ-connected on the low-tension side cannot have both primaries and secondaries paralleled with simple Δ-connected or simple Y-connected groups, owing to the relative displacement of the phases delivered.

The Storage Battery Substations of the Metropolitan Street Railway, New York City.

The open-conduit street-railway system installed by the Metropolitan Street Railway Company in New York City during the last eighteen months has been patronized much more heavily than was anticipated by its officers, the public demand absolutely requiring the operation of about 50 per cent. more cars than the company originally intended to run this winter. The two temporary power stations* with between them a rated electrical output of about 10,000 horse-power, are entirely insufficient for this, and two 850-kw generators were hastily installed for temporary service in the 70,000-hp three-phase station under erection. As the load grew last summer it was soon recognized that these would not prove sufficient, and the company determined to put in two storage-battery substations to tide it over the difficulty by taking off the peak of the load this winter, and to serve permanently to steady the voltage on the network when the multiphase plant is in operation. One of these is located in the old horse-car barns at the foot of West Twenty-third Street, on the Hudson River, and the other is also in a structure formerly used as a barn on Thirty-second Street and Park Avenue. The two substations are very much alike, and the description of the former will therefore serve for both.

The first peculiarity striking the observer is the fact that there are two batteries in multiple with each other, each of 270 cells. These are of the Chloride type, with extra heavy plates, as specially made for railway work by the Electric Storage Battery Company. The division into two batteries which are constantly run in parallel is to cut down the awkward size of tanks and plates which one battery of the same capacity would have, and also to allow work on the batteries requiring a shut-down to be carried on with one-half the equipment in service. Each battery is rated at 8000 ampere hours at a ten-hour discharge rate and 4000 amperes for one hour, the two thus giving 8000 amperes on a one-hour discharge rate. A comparison of this capacity with that of the Chicago Edison battery is interesting. The latter is rated at 24,000 ampere hours at a ten-hour discharge rate, but it has only 166 cells instead of the 540 in the Metropolitan battery station, so that the kw-hour capacity of the substation in New York City is about 10 per cent. greater than that in Chicago.



Elec. World, N.Y.

The cells are built and mounted in the usual way, with ash tanks mounted on porcelain insulators on angle-iron racks. A large part of the battery room is double-decked with the usual running boards to enable the attendants to reach the upper cells. In a small compartment isolated from the battery room are the switchboard and booster. The method of feeding and controlling the battery is quite different from anything ever used heretofore. There is no tie line between the substation and the power station which feeds it, which is the temporary station at Twenty-fifth Street and Lexington Avenue, about one mile away. Eight sections of the Sixth Avenue and Eighth Avenue and Twenty-third Street lines, in the neighborhood, supplied with current through feeders fanned out from the generating station, are also tapped off through feeders to the battery substation. These eight substation feeders are brought in through regular feeder panels to the bus bars of the battery substation, so that the current in them is sometimes flowing in one direction and sometimes in the other, according to whether the battery is charging or discharging, and sometimes in through one and out through another, if the voltage happens to be high on one section and low on another. The battery is worked with a booster to assist it charge and discharge, but at certain hours is connected straight across the buses and allowed to float, the daily cycle being somewhat as follows: From 7 A. M. to 9 A. M. it discharges to carry the morning peak; from 9 A. M. to 12 M. the booster is shut down and the battery floats on the line; from 12 to 4 P. M. it is partially recharged; from 4 P. M. to 8 P. M. discharged; from 8 P. M. to 12, allowed to float, and during the balance of the night fully recharged.

The motor-driven booster is a direct-coupled set, the generator end being rated at 3000 amperes and 80 volts. Both motor and generator are six-pole machines, the generator having two commutators, one at either end of the armature, to carry the enormous current at the low voltage. The performance of this machine is quite remarkable, as its differential field winding often gives practically zero field excitation, even with considerable current flowing in the armature, so that there is no commutating field. Under this severe condition the machine runs sparklessly.

The general scheme of connections of the battery installation is shown in the accompanying diagram. To the extreme left are shown two single-pole double-throw switches respectively in the two poles of one of the incoming feeder branches going to the bus bars. These switches are mounted on the feeder panels, on which there are also centre-zero ammeters to indicate the direction and magnitude of the flow of the current. The throw-over switches are for the purpose of reversing the polarity of the current delivered to any section in case a heavy ground occurs upon it, accompanied by another ground in some other part of the system. By proper connection of the switches the two grounds can obviously be thrown to the same polarity, this preventing them from becoming a short circuit. Obviously these switches in the substation cannot be thrown over without a short circuit unless the polarity of the current delivered from the generating station to the same section is simultaneously reversed, and this is always arranged for by telephone. The normal position of these switches when the system is free from grounds is such as to deliver to consecutive sections on any route the current in opposite directions; for example, assuming that one section on an avenue extended from Fourteenth to Thirty-fourth Street and another from Thirty-fourth to Fifty-ninth, the switches feeding them would be so thrown as to deliver positive current to the east conductor and negative current to the west conductor of the track, on the former section, and positive current to the west conductor and negative to the east on the other section, so that the direction of flow through the motors of any car would reverse on passing the section break, assumed in this case at Thirty-fourth Street. By this means a ground in the car is alternately thrown from one polarity to the other, and in case of other grounds the car can soon be located by watching the ammeters, or often by the opening of the circuit breakers, and by telephoning from the station to the car barns the car can be called in.

Tracing the diagram further to the right it will be seen that the two batteries are connected straight in multiple with each other with a switch at each polarity of either, and a mammoth 8000-ampere circuit breaker carrying the current to both from the positive bus. This is a General Electric Form K breaker, the whole switchboard being supplied by the General Electric Company. To prevent the booster generator from working as a series motor and running away in case the booster motor circuit is opened, the circuit breaker in the motor supply is mechanically connected with the trigger of the circuit breaker in the booster generator line in such a way that the opening of the former trips the latter, opening both circuits. A remarkable feature of this installation is the fact that the circuit breaker is shunted by a heavy switch, so that in case it is desired to carry more current than the circuit breaker will permit to pass it can be thrown out of service. It is expected that this will be the case, as all parts of the system are heavily overloaded, and the instructions given to both generating and battery stations are to keep current on in emergency, practically up to destruction.

In series with each battery there is also an ammeter with a scale running up to 1500 amperes in the charging direction and 3000 discharging. At the negative end after passing through the switches the battery circuits are again connected and brought to the middle point of a double-throw switch, which, thrown up, connects the battery straight to the negative bus, and, thrown down, connects it in series with the booster. In the up position the battery is, of course, floating and in the down position, which is that shown in the figure, the charge or discharge can be assisted at the will of the attendant. The two commutators are in multiple and the equalization of the load between them is effected by changing the lead of one or the other set of brushes. The division of the load is indicated by means of a centre-zero ammeter shunted across the two

*See THE ELECTRICAL WORLD September 10, 1898.

upper terminals of a Y-shunt, composed of the fork of one of the leads to the two commutators, as shown. A bracketed voltmeter is shunted around one of the switches to indicate the difference between the battery and the line voltage, and allow its adjustment to zero before closing the circuit.

The booster is, as indicated, differentially wound, the series coil being so connected as to add to the battery voltage on discharge, and subtract from it on charge, so as to compound the battery to a certain extent, and render the voltage of battery and booster uniform with variations of load. The battery, however, works very well in multiple with the station one mile away when floating, owing to the drop in the feeders. The fine wire or independent excitation is connected up, as shown, to a dial rheostat with two resistances, which are permanently connected in multiple straight across the 500-volt buses. The diametrical contact arm when in a vertical position connects the field winding across the middle points of these two resistances which—having the same potential—give the field no current. Deflected in either direction, however, the arm brings the field terminals respectively toward opposite buses, and gives a current in the field winding, which can thus be varied from maximum in one direction to maximum in the other without opening the field circuit for reversal. Thus, rotating the arm in one direction helps the battery to charge, and in the other direction helps the battery to discharge, the series field superposing on the excitation of the fine winding an exciting force which helps the battery to take up the fluctuations in the load. The station works, of course, in close co-operation with the generating station, and in case the latter wishes part of its load lifted, the sub-station is called up by telephone and the attendant instructed to give the battery a smaller charge or heavier discharge. This he does by moving his field switch.

The two batteries in this sub-station were put in operation about the middle of December, 1898, and immediately loaded with the Christmas traffic and the extra work caused by the snow-storm which followed. They regularly lift from the generating station at the afternoon peak from 1500 to 2000 amperes, thus relieving the plant of a load equal to the full output of an 850-kw generator.

Additions to the Electrical Apparatus of the Massachusetts Institute of Technology.

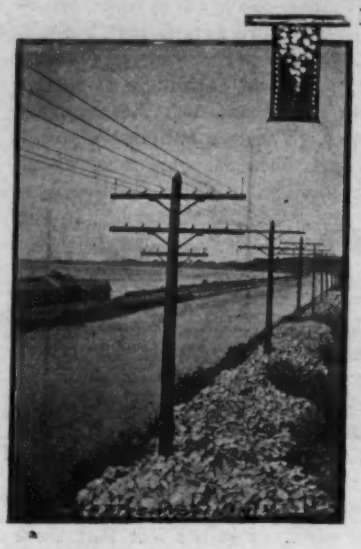
The equipment of the electrical laboratories of the Massachusetts Institute of Technology has been materially improved by the addition of a complete experimental plant for use in dynamo testing and dynamo-electric measurements. It consists of two similar four-pole moderate-speed 25-kw direct-current compound-wound generators made by the General Electric Company. They are belt-driven by a Westinghouse compound engine, fitted with indicators, a throttling calorimeter and a surface condenser discharging the condensed steam into weighing tanks. The two generators are set up in line with each other, and arranged with flanges by which a coupling shaft may be put in, rigidly connecting the two together. They are also fitted with a plug switchboard, by which any desired arrangement can be made of the series, shunt and armature windings of the two machines with any one or more of ten switchboard Weston ammeters and voltmeters of suitable ranges. With the various combinations that can be obtained of electric and mechanical connections, all commercial tests and many special experimental determinations of the properties of the machines may be made.

The laboratory has also in regular use an equipment for the determination of wave form by the contact method, which is applied to transformers, condensers and reactive coils, and also to the study of wave form and the angle of lag in polyphase apparatus. The study of insulating materials under high electrical pressures is carried on by means of a high-voltage testing transformer, voltmeter and spark micrometer. The Institute has now a new lighting and power plant in its building on Trinity Place, fitted with two Westinghouse multipolar three-wire generators, each capable of giving a current of 350 amperes at 220 volts, or 350 amperes at 110 volts on either side of the system. Each generator armature is carried by the extended shaft of a 100-hp Westinghouse compound engine running at 300 r. p. m. Switchboard instruments and wiring are especially arranged for experimental work with these generators.

The photometer rooms are furnished with an unusually elaborate equipment for the testing of arc and incandescent lamps of any size or power. For the former a new form of radial photometer has been devised and constructed at the Institute, which avoids the use of reflectors and the errors involved thereby.

The Delivery and Distribution of Niagara Power in Buffalo.

THE LINES.



THE Niagara Falls Power Company sends power to Buffalo over 24 miles of overhead pole line. This consists at present of six bare stranded cables of 350,000 circular mils each, placed on a six-pin cross arm, making two three-phase circuits, one on either side of the poles. These are transposed at five points by carrying the inside wire over to the outside on extra cross-arms on two poles. The transposition poles are the same for both circuits. The pressure used is 11,000 volts, although it is planned to eventually raise this to 22,000 when the demand necessitates the increase of the transmitting capacity of the line by this method. At the city limits of Buffalo the power is taken over by an allied company known as the Cataract Power and Conduit Company, which distributes, transforms, delivers and sells it to various consumers, the number of which is rapidly growing. At present the incoming line of the company is for a distance of about three miles carried overhead from the city limits to a cable terminal at the side of the Erie Canal. The underground lines will, however, soon be extended about two miles. The new terminal house contains a complete equipment of Wurts lightning arresters and a plug board fitted for four overhead and six underground three-conductor lines.

From the cable terminal all the lines of the company are under ground and are divided into two general classes, the high-tension, that is, those now carrying the 11,000 and planned for 22,000 volts, and the low-tension or 2200-volt lines. Of the former there are 80,000 feet of three-conductor cable running in duplicate to the three transformer stations of the company, and branching from these to the consumers' premises are about 23,000 feet of three-conductor 2200-volt cable. All lines are drawn into Camp vitrified conduit, of which there are between 800,000 and 900,000 duct feet

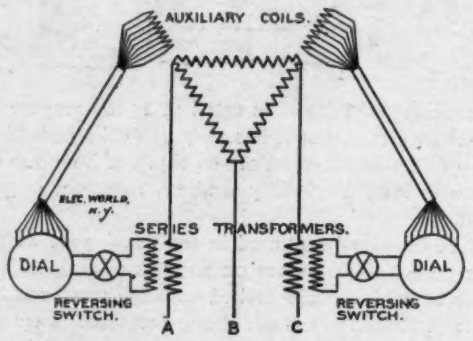


Fig. 1.—Diagram of Regulating Transformer Connections of No. 2 Substation.

laid. All of the high-tension cables laid as yet have 000 cores per phase insulated with a double rubber cover 9-32 of an inch in thickness, with a jute filler to preserve an approximately cylindrical shape of the cable sheathe, the whole being made by the General Electric Company. Some Habirshaw cable is, however, soon to be put in.

The low-tension or 2200-volt cables are also three-conductor inside one lead sheathe, each phase having a 0000 cross section. paper-insulated, also rounded out with a jute filler. About 14,000 feet of this cable has been supplied by the National Conduit and Cable Company, the rest being the work of the Standard Underground Cable Company. Some single-conductor safety cable is also used.

SUBSTATION NO. 1.

The first transformer substation reached by the high-tension lines is the No. 1 Station, which consists of a room in the power house

of the Buffalo Railway Company. Here are six stationary air-cooled General Electric transformers rated at 275 kilowatts each to lower the line pressure of 11,000 or 22,000 volts to 360 volts for the rotary converters in the power plant nearby. Three others of 250 kilowatts each deliver 2200 volts for branch lines to neighboring consumers.

SUBSTATION NO. 2.

Substation No. 2 is situated down on Ohio Street convenient to mills, elevators and other heavy consumers. It consists of a special brick building 100 by 20 feet in size, built—on account of the danger of fire in the neighborhood—much after the style of a fireproof vault. There is the usual concrete, cement-lined floor, and the roof is also of tile-arch construction sprung between I-beams, the walls rising above the roof, which is copper-covered, making of it an open tank or reservoir. The roof is fitted with a 4-inch water supply main sufficient to flood it in case of emergency, and give a complete water screen about the sides of the structure. It also may be used as a storage tank to tide the water-cooling system over an interruption of the supply. The windows and doors are fitted with fireproof shutters, which may be closed from within, and also with perforated pipes for water screens. The room is served by a traveling crane capable of picking up the heavy transformers. A general view of the interior is shown in Fig. 2.

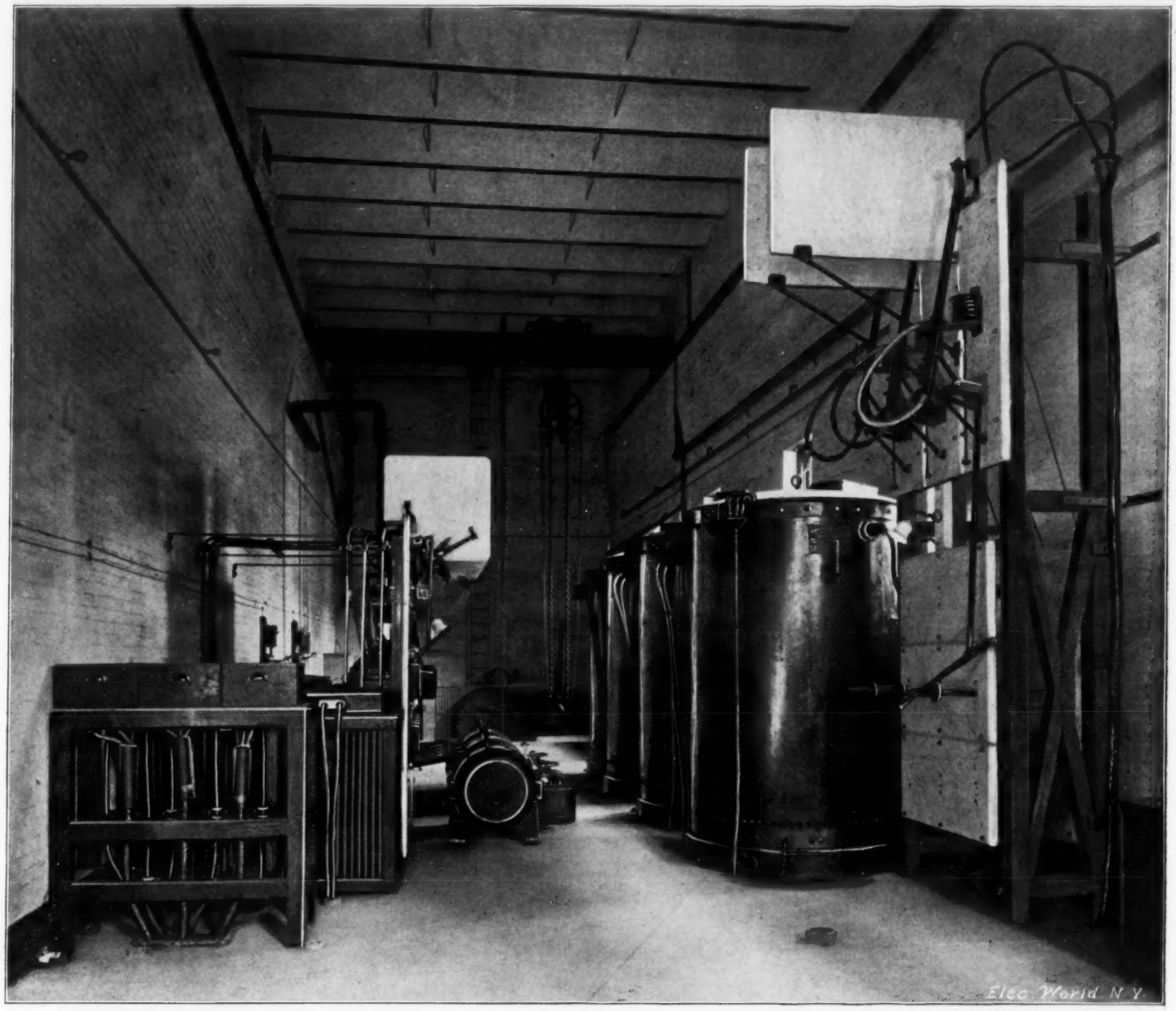


FIG. 2.—A GENERAL VIEW OF THE INTERIOR OF THE OHIO STREET OR NO. 2 SUBSTATION.

The transforming equipment consists of four 850-kw Westinghouse transformers, next to those of 935 kilowatts in the Niagara Falls power plant, the largest in the world. They are oil-insulated and water-cooled by means of three coils of pipe within the upper part of the boiler-iron cylindrical case enclosing the oil, this case being roughly 5 feet in diameter by 9 feet in height, the weight of the transformer with case and oil being about 19,000 pounds. Three of the four are star-connected across the three-phase incoming high-tension lines, their secondaries of 2200 volts being delta-connected. The fourth transformer is held in reserve. Besides these there are six 75-kw boosting transformers of the self-cooling type, which are worked in pairs to regulate the voltage delivered from three feeder panels, one pair of boosters serving to raise the pressure of all three phases for one feeder by an ingenious system described previously in these columns, and shown schematically in Fig. 1*.

This equipment is one-third of that which the structure will accommodate, giving a transforming equipment, if filled on the present lines, of 7650 kilowatts, or over 10,000 horse-power. As the floor area is 2000 square feet, this shows a capacity of 5 horse-power per square foot, and that not simply transforming capacity, as a 15 per cent. regulation can be obtained, which is as much as is needed in generating plants. This is all accomplished on one floor level and with about 20 per cent. of the space allowed for storage and reserve apparatus. It is interesting to compare it with the figures for generating stations. The most compact Edison stations built on the plan generally known as "on edge" can obtain an economy of ground space of 2 horse-power per square foot, while single-deck stations always come below one-half of this value.

Of switchboards there are two, one (see Fig. 4) in the primary high-tension lines and one (see Fig. 3) in the secondary compara-

*See THE ELECTRICAL WORLD, April 8, 1898, page 435.

tively low-tension lines. The former consists of three double panels, each panel consisting of two marble slabs, one behind and about 20 inches from the other. The switching is accomplished by means of long rods or plugs which push through from panel to panel much like the transfer plugs of modern arc-light boards. By this means any one or more of the three 3-phase groups of transformers for which the station is planned can be connected across the three phases of one of the two incoming high-tension lines. Another similar board will be used for the other line. The incoming lines are also fitted with circuit breakers on these boards, probably the highest tension and longest break circuit breakers ever constructed. They have the ordinary copper primary and carbon secondary or following break, both mounted on the upper end of a vertical arm about 5 feet long. This, when released by the ordinary trigger, is thrown out to a horizontal position, giving an opening of about 6 feet. There is, of course, one of these breakers for each phase of the incoming lines, each with its own trigger and magnet, the three arms rotating independently on one shaft with insulating couplings between the arms designed to withstand the high tension across them. By means of a handle attached to this shaft they can all be restored together, and the group is fitted with another handle to trip them together, the breakers themselves being placed high up out of reach. The three arms are separated by mammoth marble barriers to prevent an arc jumping across between them.

The low-tension board has three panels, one for each of three outgoing feeders, each carrying three circuit breakers designed for 2200 volts, similar to the high-tension ones, but on a smaller scale, the opening being only about 18 inches. Each panel also carries three ammeters, one for each phase, one voltmeter which can be connected across any of the three phases, two integrating Shallenberger wattmeters connected up to measure the total outgoing power to the feeders on the two-wattmeter method, and three protected knife switches, each blade having a heavy hard-rubber shield embracing it so that it cannot be accidentally touched by hand. The voltmeter plugs are connected up through Mershon compensating devices designed to subtract from the bus-bar pressure both the ohmic and inductive drop of the feeder to which they are attached, and thus give a reading such as would be obtained by a pilot wire running back from the far end of the feeder. These compensating devices are, of course, of the series-transformer style, and are fitted with adjustments by which either the non-inductive or the inductive factor may be independently adjusted. All the apparatus of this station was constructed by the Westinghouse Electric & Manufacturing Company.

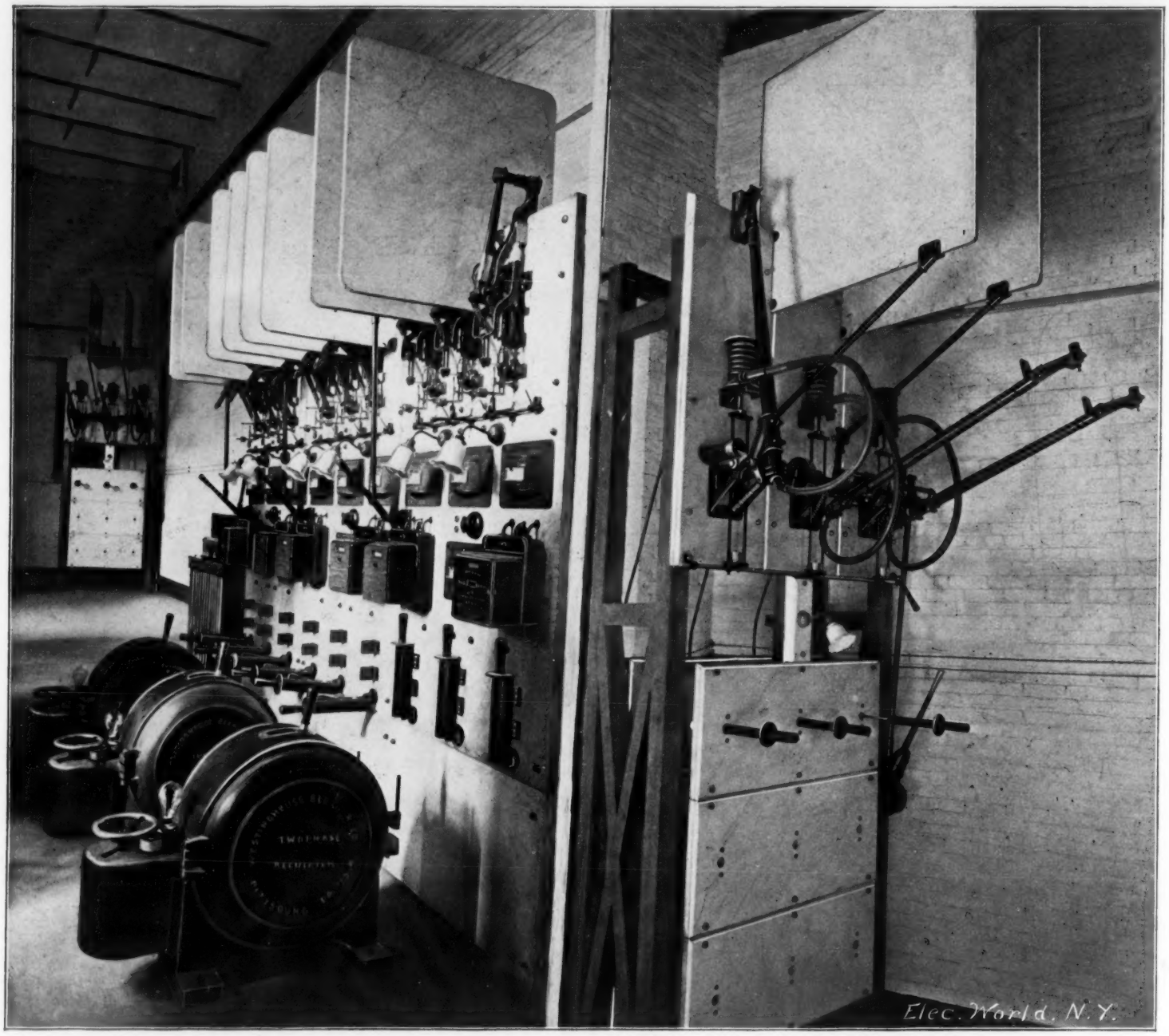


FIG. 3.—THE 2200-VOLT SWITCHBOARD IN THE OHIO STREET SUBSTATION.

FIG. 4.—THE 11,000-VOLT SWITCHBOARD IN THE OHIO STREET SUBSTATION.

SUBSTATION NO. 3.

Substation No. 3 is immediately adjacent to the new Seventh Street transformer station of the Buffalo General Electric Company, a full description of which will appear in the next issue of THE

ELECTRICAL WORLD. The room, which is a part of the structure belonging to the latter company, is 50 by 25 feet in size, of fireproof construction and fitted with the usual traveling crane. In two rows down the centre of this room, as shown in Fig. 5, stand twelve 250-kw General Electric air-insulated forced-draft transformers, taking the high-tension current at 11,000 or 22,000 volts and transforming it to 352 volts, at which pressure it is delivered to the Buffalo General Electric Company. These twelve transformers are connected up in four groups of three each, both primaries and secondaries of the three transformers of each group being delta-connected. This obviously gives, when all the transformers are connected up, a bank of four transformers between each pair of the eight taps brought up to a terminal plate in the top of each transformer. By changing the connections about 12 per cent. of the primary turns may be cut out in eight steps, and the induction in the iron at constant impressed voltage—and consequently the ratio of transformation between the primary and secondary—may be changed by the same percentage. This is for use when the line drop is altered by doubling the voltage. From this terminal plate in the top of the transformer four flexible rubber-insulated cables are brought out through corrugated porcelain bushings, and by means of these four connections the two primary windings may be connected either in series or in multiple, thereby allowing a change of the working pressure from 11,000 to 22,000 volts. These four pri-

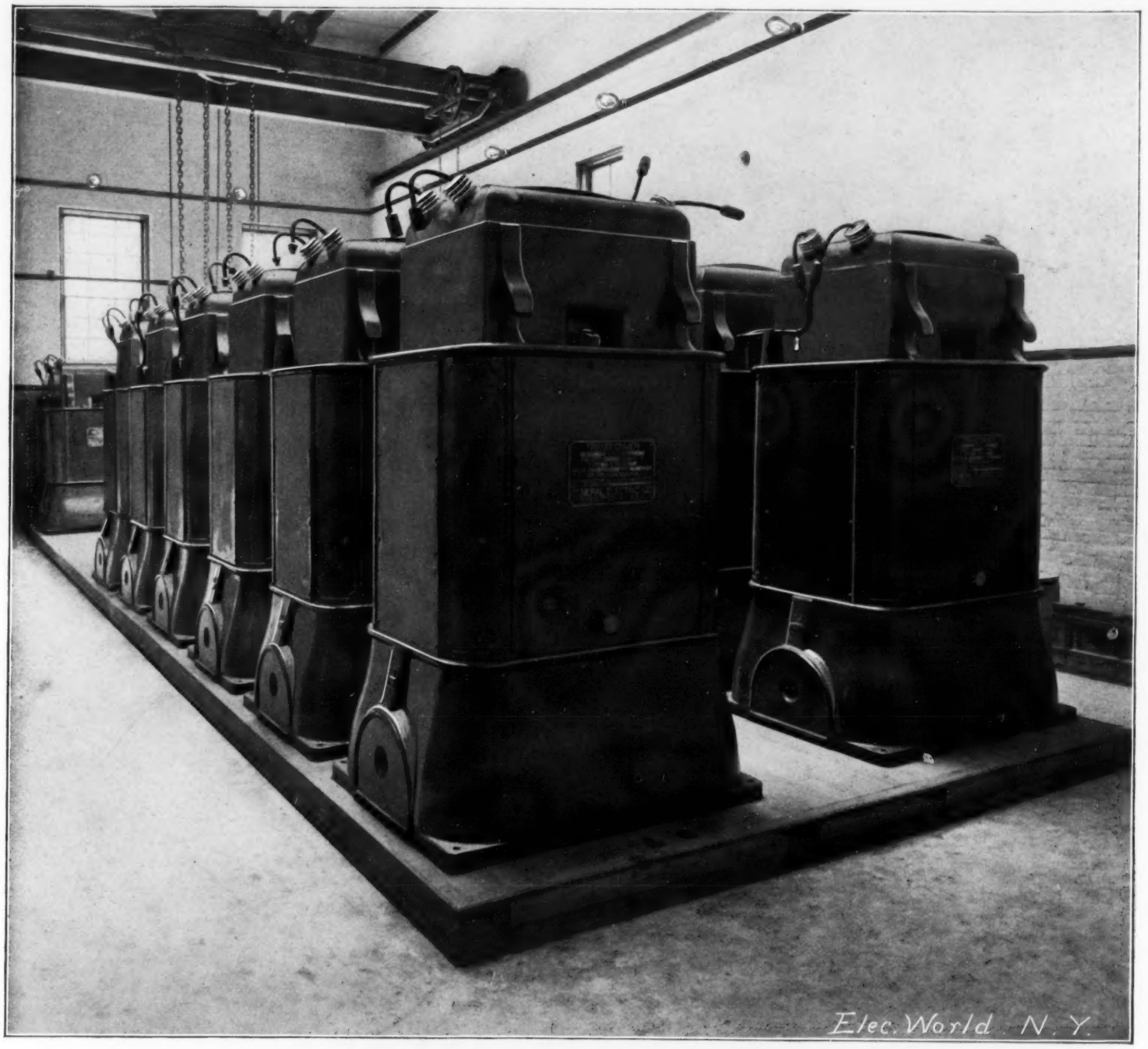
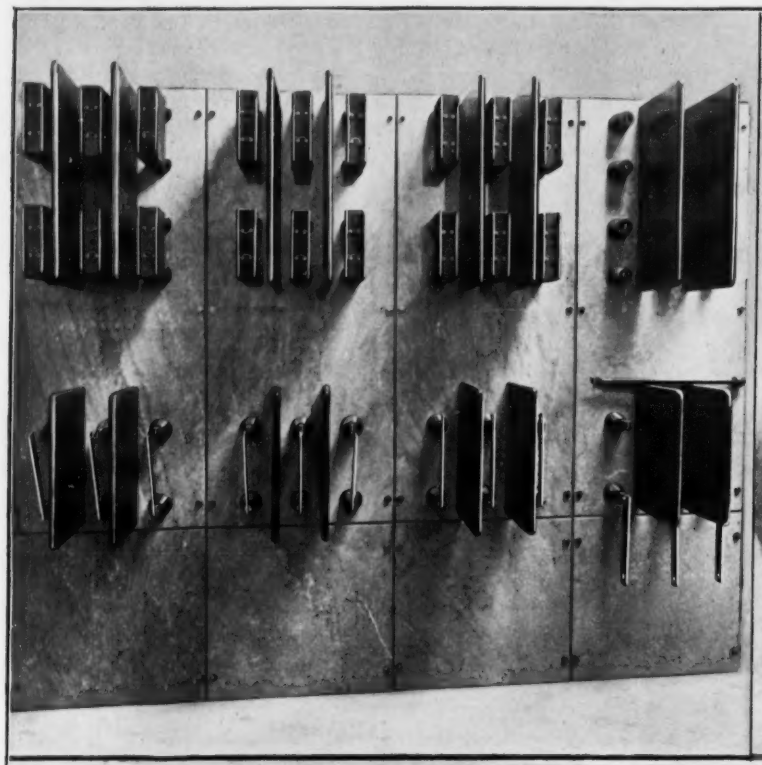


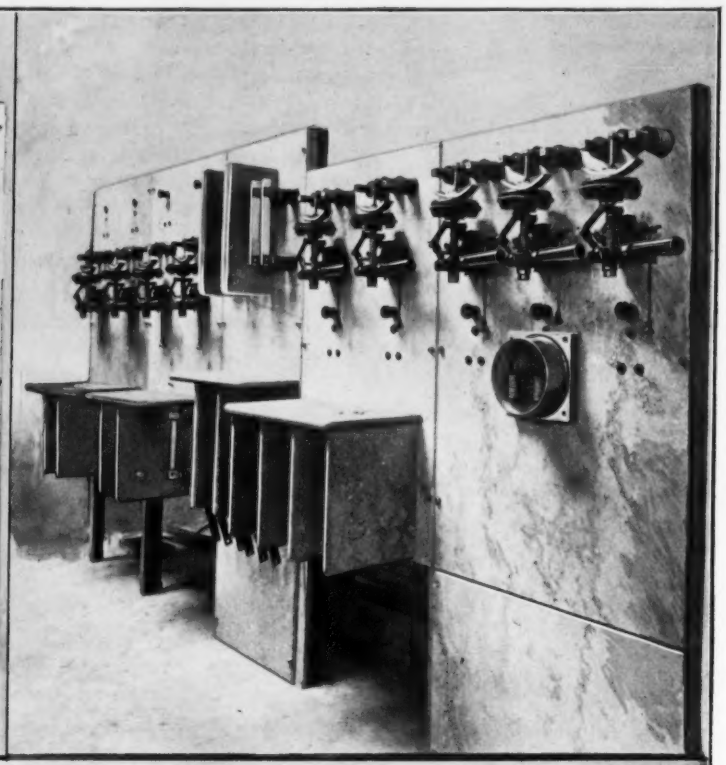
FIG. 5.—THE TRANSFORMERS IN SUBSTATION NO. 3.

three buses (either primary or secondary), the arrangement being that shown in Fig. 10. Beside these twelve transformers there are four others, three transforming from the incoming line voltage to 2200 volts for loads in the neighboring district, with one to spare.

The transformers all rest on wood, although their cases will be grounded, over an air chamber, which is cut off from the rest of the basement by brick walls, an air pressure of one-half to three-quarters of an ounce per square inch being maintained in this basement compartment by means of one or more of three blowers driven by induction motors. A variable ratio of transformation is obtained by means of a variation in the number of primary turns by means of mary outlets are connected to lead-covered leads which run down through stand pipes and thence under the floor to the primary switchboard, by means of a special coupling or connector resembling somewhat a hose-coupling. A disc terminal is sweated on to the end of each cable, the faces of the two discs being brought together with a gauze washer between them to give many points of contact, two hard-rubber sleeves surrounding the two disc terminals being afterward screwed together, holding the discs firmly against each other and insulating the whole.

Down one long side of the room is a magnificent piece of special switchboard work about 40 feet long. Three views of this are shown





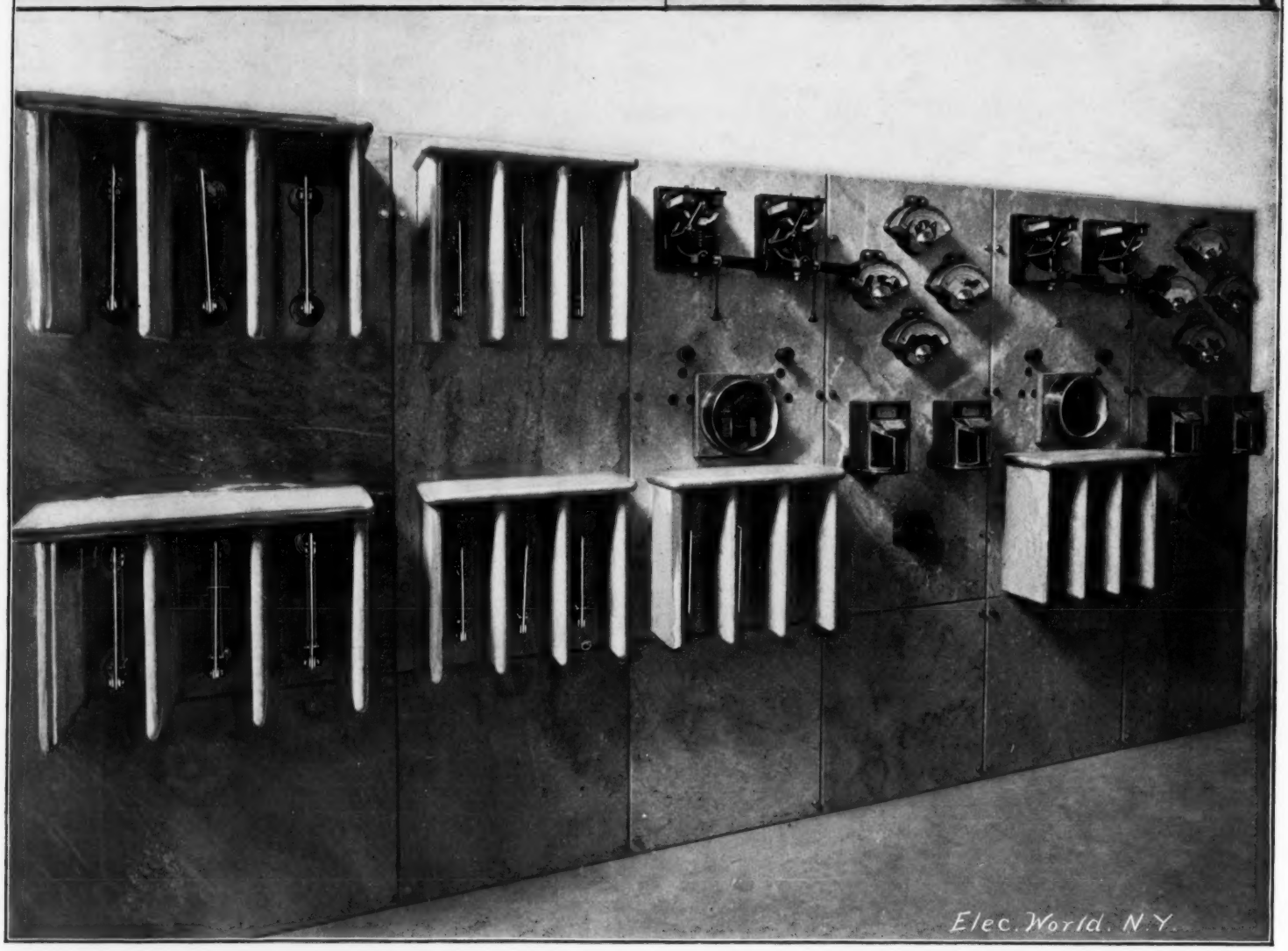


Fig. 6.—The Distributing Panels of the High-Tension Side of the 11,000-Volt 352-Volt Transformers.

Fig. 7.—The Circuit-Breaker Panels of the 11,000-Volt Lines.

Fig. 8.—The Distributing Panels and Outgoing 2200-Volt Feeder Panels of the 11,000-Volt 2200-Volt Transformers.

The High-Tension Switchboard in Substation No. 3, Shown in Three Sections, Fig. 6 being the Left-Hand End, Fig. 7 the Middle, and Fig. 8 the Right-Hand End of the Board.

on page 80, the surroundings being such that a single photograph could not be taken of the whole board. The upper left-hand view shows extreme left end of this structure of blue Vermont marble; upper right-hand view shows middle section and lower view the right-hand end. The four panels to the left-hand end, that is, those which are shown in Fig. 6, are what are known as the distributing panels of the high-tension side of the four delta-connected groups of transformers giving their output at 352 volts. On the lower part of each panel are three high-tension knife switches separated by wooden barriers and connected into the three incoming leads to the other by the removal of the overload to stop the motion of the clockwork and restore it to its normal position. The purpose of these devices, on a system that has many points of protection in the transmission lines, is to open a short circuit at the breaker nearest to it without affecting those further back toward the power house. For this purpose the time mechanism is so set that, although all clocks should start at once due to a short circuit, say, in Buffalo, the breaker nearest to it in the system would first be opened, which would remove the overload and restore the clock mechanism of all the others, without opening the circuit at their respective breakers.

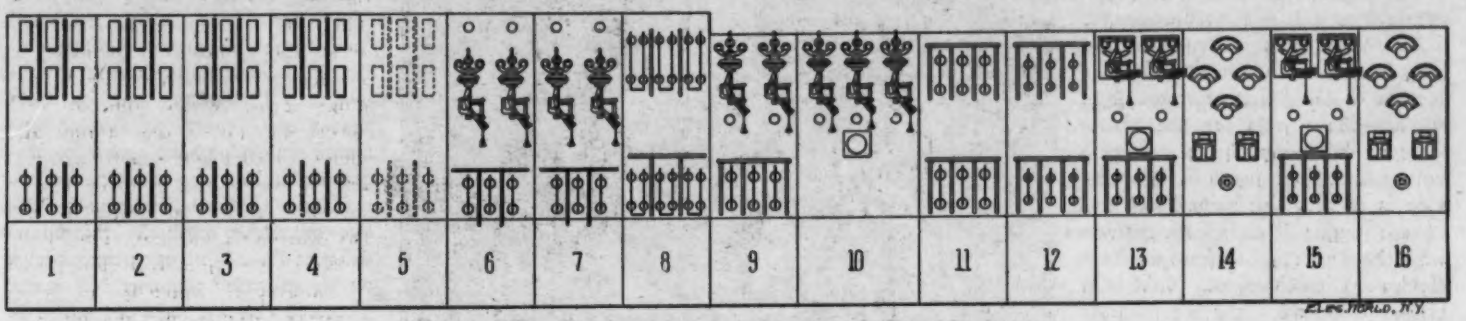


FIG. 9.—KEY TO SWITCHBOARD SHOWN ON OPPOSITE PAGE.

Panels 1, 2, 3 and 4, Distribution Panels of High-Tension Side of 11,000-Volt 352-Volt Transformers. 5, To be Similarly Occupied, but now Vacant. 6, Reserve Reverse-Current Circuit-Breaker Panel, Space to be Occupied by a Panel Similar to Nos. 1 to 5. 7 and 9, 11,000-Volt Reverse-Current Circuit-Breaker Panels. 8, Loop Panel to be Taken Out and Left Vacant. 10, Circuit-Breaker Panel with Time Element, Protecting 11,000-Volt 2200-Volt Transformers. 11, Distribution Panel of High-Tension Side of Six 11,000-Volt 2200-Volt Transformers. 12, Distribution Panel of Low-Tension Side of the Same. 13, 2200-Volt Feeder Panel with Time-Element Circuit Breakers. 14, Instrument Panel for Same Feeder. 15 and 16, Similar to 13 and 14, respectively.

corners of the delta, as shown in the diagram, Fig. 12. Above them on each panel are six pull-away fuses with long swiveled arms, giving a wide break, the six fuses being inserted between the corners of the delta and the transformer windings proper, as shown in the same diagram. Both fuses and switches are isolated by wooden barriers, and similar barriers are also mounted on the back of the board between the connections of different polarities.

To the right of these panels, and shown in upper right-hand illustration, Fig. 7, are other panels, each of which carries, as shown, three stalls, carefully isolated by marble barriers and marble tops, containing switches similar to those on the panels just described, and above them two circuit breakers, a better view of which is shown in Fig. 13. These breakers, which are in the 11,000-22,000-volt circuits, are operated by magnetic triggers, in turn controlled by contacts, in some instances actuated by clockwork similar to that shown to the right of the illustration, and in other instances by special reverse-current devices described below. These breakers are shunted by fine copper fuses in plugs, the heads of which appear on the board. The time mechanism is exactly like that described and illustrated on page 13 of the issue of THE ELECTRICAL WORLD of January 7, each clockwork containing two magnets, one affected by a feeder overload to start the clock into action and the

The reverse-current device is not yet in place, and will consist of instruments on the sub-bases, which are shown incomplete in Fig. 7, these instruments closing the contacts of the breaker trip coils. The instruments consist of rotatable short-circuited secondaries resembling greatly those of induction motors, held up against a stop by the rotating field generated within them by their stationary primaries, and fitted with a device which, in case the direction of rotation of the field reverses, closes the local circuit through the breaker coils. The primary of each of these induction instruments is wound with one current and one potential winding, and so long as the flow of energy is toward the substation from the incoming feeder they remain against their back stops, but should the direction of flow reverse for any reason, the armature turns, closing the contact of the local circuit and opening the breakers of the corresponding line. The purpose of these instruments is illustrated by the diagram in Fig. 11. There are to be in constant service from Niagara Falls two feeders to the various substations, and it is required to fit them with devices such that should a short circuit occur on either of them, that one will cut out at both ends, leaving the other in continuous operation through the system. In case of a short circuit on one feeder, as at *X*, the current would tend to feed back from the other feeder, which is

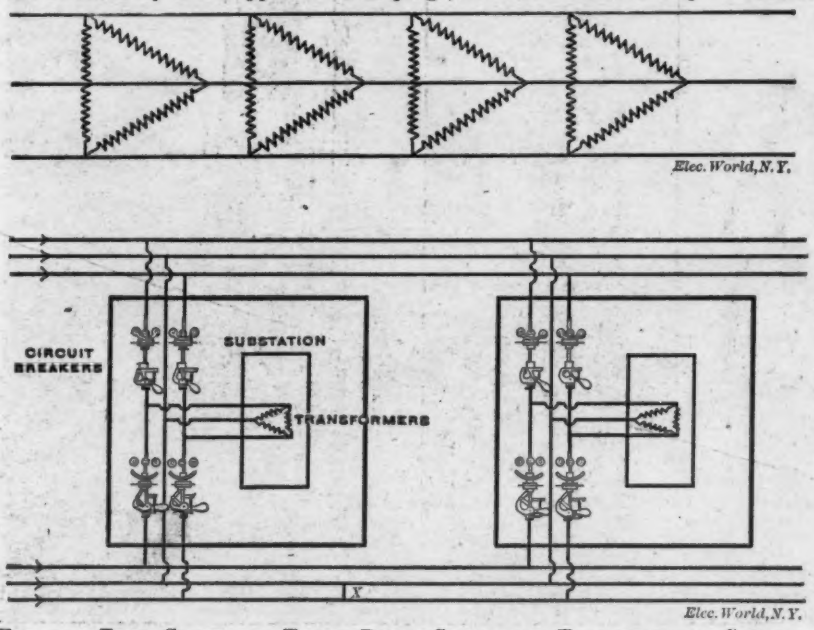


FIG. 10.—FOUR GROUPS OF THREE DELTA-CONNECTED TRANSFORMERS, GIVING THREE BANKS OF FOUR TRANSFORMERS IN EACH PHASE.

FIG. 11.—DIAGRAM SHOWING THE CONNECTIONS OF THE REVERSE-CURRENT CIRCUIT BREAKERS.

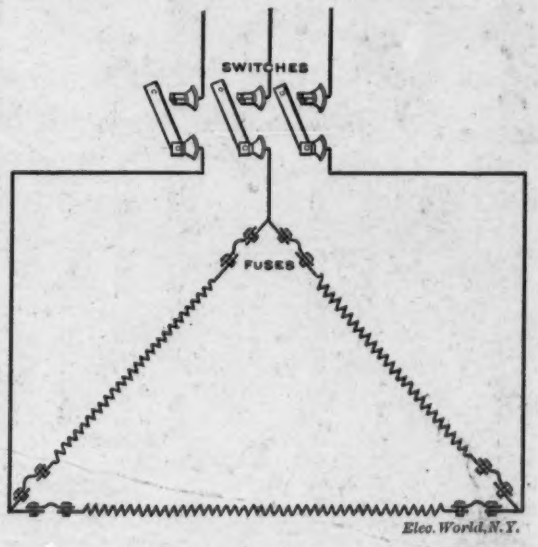


FIG. 12.—THE ARRANGEMENT OF SWITCHES AND FUSES IN THE 11,000-VOLT 352-VOLT TRANSFORMER LEADS.

tied to it at all the stations. This would throw plain overload breakers on both sides and cause an interruption of the service. With these reverse-current breakers, only the instruments on the branches from the short-circuited line will be affected, those on the other line getting an overload, it is true, but in a direction such as not to affect them.

It will be noted that one conductor of each feeder is carried through without a circuit breaker, but as any short must involve two conductors it is sure to be opened.

At the right-hand end of the long board, as shown in the lower section of the illustration on page 80, are the panels for the transformers stepping down to 2200 volts. The first panel of this service is that to the right-hand end of the upper illustrations, shown with three circuit breakers above a clockwork mechanism. This is a plain overload, three-conductor breaker with the time element. To the right of it is a panel with six stalls containing switches, this being the distribution panel to the high-tension side of two groups of delta-connected transformers. A similar distribution panel for the low-tension or 2200-volt side follows to the right. Beyond those is a panel with two breakers, a clock mechanism and three switches, this being a switch and circuit-breaker panel with time element for one of the outgoing 2200-volt feeders, and immediately to the right of it is the instrument panel for the same feeder, carrying a voltmeter, three ammeters and two wattmeters. Still further to the right are two similar panels for another feeder.

Fig. 13.—Two Circuit Breakers for 22,000 Volts.

The low-tension or 352-volt board, illustrated in Fig. 14, consists also of four panels, one for each group of transformers, with switches and ordinary open aluminum fuses on marble slabs behind the board, arranged with regard to the corners of the delta of the low-tension windings in the same way as are the switches and fuses of the high-tension windings described above and shown in Fig. 12. The low-tension switches are of the single-pole, single-throw, divided-blade, quick-break type, three switches to a panel, throwing the secondaries of the different groups in multiple on one set of three-phase bus bars. The board is also equipped with three Thomson inclined-coil alternating-current voltmeters, with plugs to throw any one of them across any phase, one similar ammeter for each phase and two integrating wattmeters connected up to measure the total output by the two-wattmeter method. This board delivers its output over cables with an aggregate capacity of some 5,000,000 circular mils per phase to the wire tunnel of the Buffalo General Electric Company's plant on the other side of the wall. All the apparatus in this sub-station was made by the General Electric Company.

The officers at the head of the Cataract Power & Conduit Company are George Urban, Jr., p esident; Charles R. Huntley, vice-president and general manager; W. B. Rankine, secretary and treasurer; De Lancey Rankine, assistant secretary and treasurer, and H. B. Alverson, from whom the above interesting information was obtained, superintendent. As electrical director of the Niagara Falls Power Company, which has a large interest in the Cataract Power & Conduit Company, Mr. L. B. Stillwell is responsible for all the electrical work of the latter company, and much of the original work is from his designs.

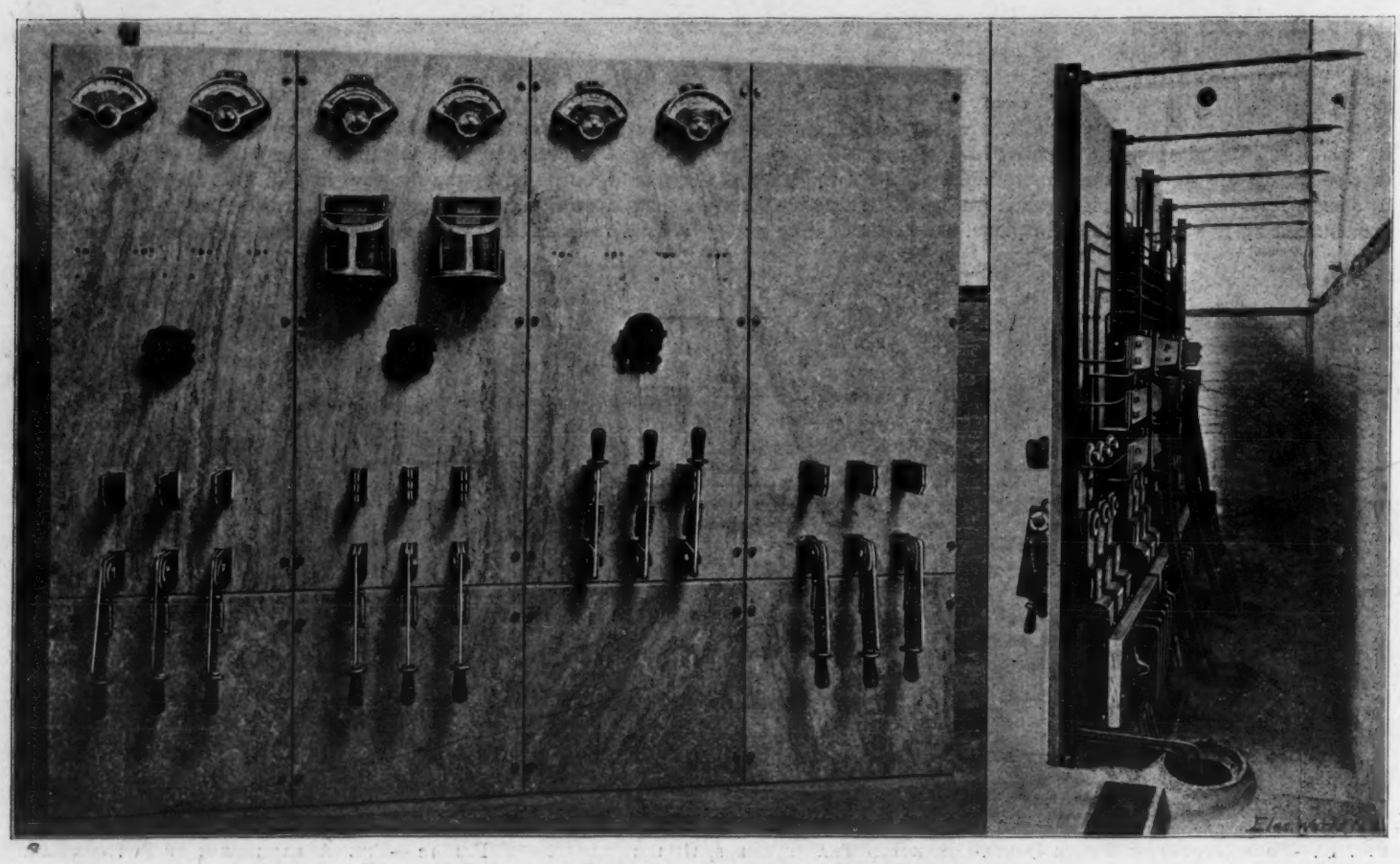


Fig. 14.—Front and Rear Views of the 352-Volt Switchboard.

Telegraphing Without Line Wires—II.

BY WILLIAM BISSING.

ELECTROSTATIC INDUCTION METHODS.

The electrostatic system may be said to represent an intermediate stage in the development of the art of telegraphing without line wires. Some of the difficulties which are met and overcome in this method of signaling, e. g., the dampening effect of intervening obstacles, occur in the modern or Hertzian wave method. In some of the patents that used electrostatic induction for their effects electrical waves occur, but, as will appear more fully below, the wave effect is lost or inconsiderable. Some of the electrostatic methods have been used, a number of years ago, in railroad signaling, examples of which are furnished by the following patents: Smith, 247,127, September 13, 1881; Phelps, 334,188, January 12, 1886; Edison et al, 486,634, November 22, 1892.

The patent to Smith was the first to describe a means of signaling by induction to a moving railway train. The metallic roof of the car which should be insulated is connected to a wire which leads to one terminal of a telephone receiver, the other terminal of the receiver being grounded through the wheels and rails. A telegraph line is strung along the track in closer proximity to the car than is customary for Morse signaling. On telephoning over the line from a station on the road the car roof is affected inductively, and a current is produced in the receiver on the car, the line and the roof forming the two plates of a condenser. An advantage of this method of transmitting signals is that the line wire along the track may be used for telegraphing according to the ordinary Morse system, without disturbing the telephonic signals. The current induced in the car circuit in this patent is probably due to both electromagnetic and electrostatic induction.

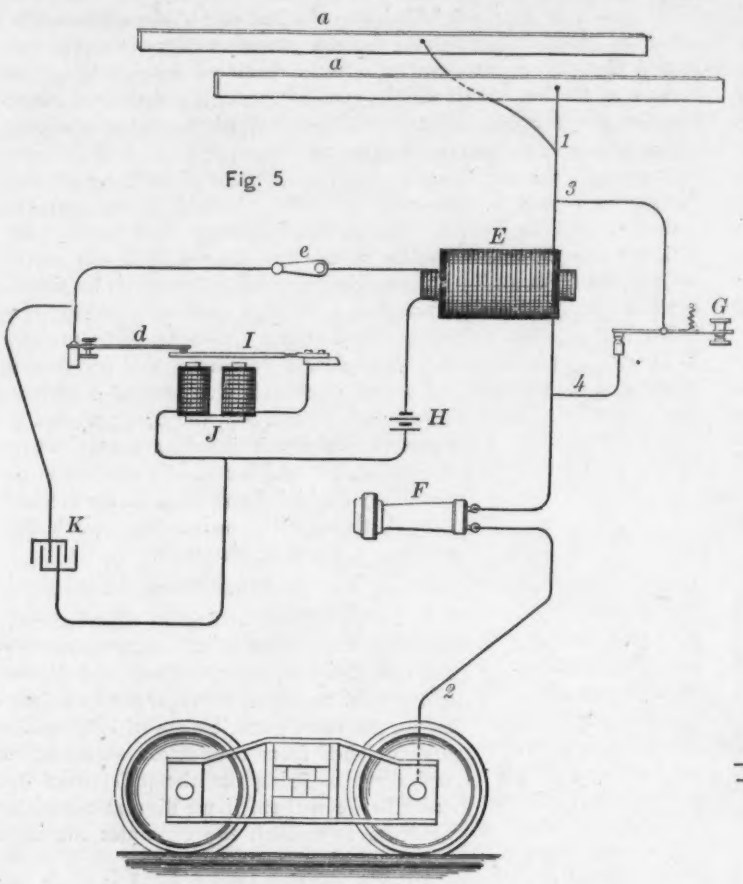


Fig. 5

In the patent to Edison, et al, No. 486,634, see Fig. 5, a pair of suitably insulated plates *aa* are placed upon the car roof, and a wire *1* connects them to one terminal of the secondary of an induction coil *E*, the other terminal of which is connected to the telephone *F*, from which a wire *2* runs to ground at the car wheel. The primary of the induction coil is connected through a switch *e* to an electromagnetic circuit breaker *I* and battery *H*. Sparking at the circuit breaker is prevented by the condenser *K*. A switch *G* normally short-circuits the secondary of *E*. A similar apparatus is placed at the sending station. In receiving signals the switch *e* is opened, and *G* is left in its short-circuiting position. The signal will then be received at *F*, the telephone taking the place of the Morse sounder. In sending signals *e* is closed and *G* depressed at intervals to produce dots and dashes according to the length of depression of the key, a series of impulses which produces a rattle in the telephone receiver being sent to line each time the key is closed. The system used in this patent resembles that used by Edison in patent No. 465,971, which will be described below. Both patents were applied for in the same year, viz., 1885.

In the patents which use induction methods treated in the preceding part of this paper the distances over which transmission is effected are comparatively short. A class of devices will now be investigated in which the inventors attempt to signal through a considerable space without using line wires. These inventions are described in the following patents: Dolbear, 350,299, October 5, 1886; Edison, 465,971, December 29, 1891; and Kitsee, 550,510, November 26, 1895.

In the patent to Dolbear, see Fig. 6, the transmitting circuit is shown at *A*, the receiving station at *B*. The induction coil *G* contains but one winding, which forms both its primary and secondary. One convolution of the coil is cut, the ends thus formed being connected with the poles of the battery f^1, which has a number of cells sufficient to establish a potential difference of 100 volts between the condenser H^1, which is attached to one terminal of the induction coil *G* and the wire *C*, which grounds the other end of the coil. A microphone transmitter *T* is included in the primary circuit. At *B* are located a magnetic telephone receiver *R*, condensers *H* and H^2, and a battery which the inventor says is arranged to charge the ground at *D* to an opposite potential from that at *C*.

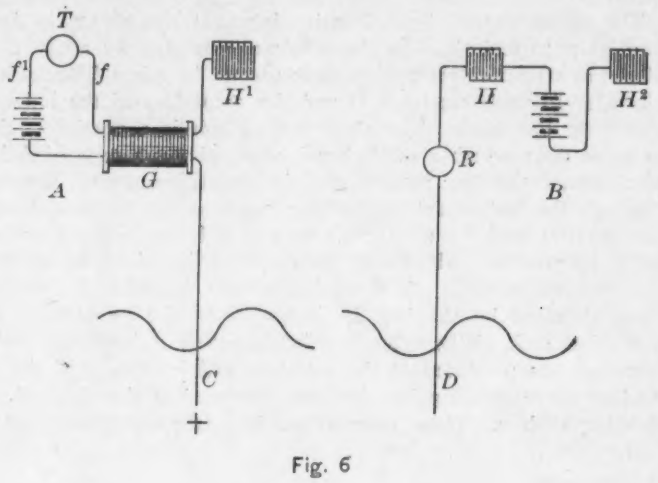


Fig. 6

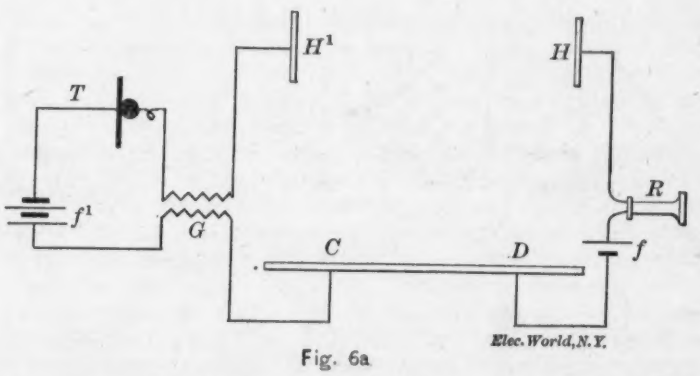


Fig. 6a

It would appear that several of the elements used by the patentee are unnecessary; he himself states that the condensers *H* and H^2 are not essential. Inasmuch as all the condensers are shown with one coating insulated, the capacity which they give to the system is small and their effect must be slight. The diagram, Fig. 6a, omits what appear to be inessentials, and gives perhaps a clearer idea of what occurs when the variable resistance transmitter *T* is vibrated. *G* represents the induction coil. H^1 and *H* form the two coatings of a condenser of small capacity. In addition to this condenser we have to take account of the fact that owing to the proximity of H^1 and *H* to the earth these plates form respectively the coatings of a pair of condensers, whose other plates are formed by the earth.

The capacity of this last-named pair is considerably greater than that of the condenser $H H^1$, for the capacity of a condenser varies inversely as the distance between the plates, and the distance from H or H^1 to earth is much less than from H to H^1. Consider now the circuit $C\ G\ f^1\ T\ G\ H^1\ H\ R\ D\ C$, in which a variable e. m. f. is produced by the vibration of T. There will be two paths for the alternating current produced by the change in the variable resistance T; one circuit beginning at the battery f^1 leads to the transmitter, then through one-half of the induction coil to H^1 to earth at C, and returns through the other half of the induction coil to the battery; the other circuit goes from H^1 to H, through the receiver R, and returns by way of the earth and through the path of the first circuit to H^1. It is the latter circuit that transmits the signals from T to R. Knowing the resistance, self-induction and capacity of each of these circuits, the amount of the e. m. f. of the battery and the variation in the resistance of T, the strength of the current in each of the two branches may be calculated. It will be seen that only a small proportion of the current produced in the local circuit $f^1\ T\ G\ H^1\ C\ f^1$ will be diverted into the receiving circuit at R. The battery at f, which is connected in series with the battery at f^1, increases the total e. m. f. in the signaling circuit, so that by means of it a given change in the resistance T will increase the current through the receiver R.

The apparatus used by Edison in his patent No. 465,971 is shown in Figs 7, 7a and 7b. In these figures two capacity areas C are placed at a suitable elevation and connected by wires I through his electromotograph receivers D and the secondary of the induction coil F to the earth. The electromotograph is a revolving chalk cylinder upon which a metal brush rests, giving a note of definite pitch (see patent No. 221,957 to Edison). When the current flows through the instrument the friction between the brush and cylinder changes, and this produces a note of different pitch. Any other form of receiver, which can be operated by alternate currents, may be substituted. A revolving circuit breaker, G, normally short-circuited by the key H, is placed in the primary of each induction coil. When the key is depressed a large number of impulses are produced in the primary, and by means of the secondary corresponding impulses are produced at the elevated condensing surface. These electrostatic impulses are transmitted inductively to the distant surface C, and are made audible by the current generated in the electromotograph connected in the ground circuit with the distant condenser plate. The intervening body of air forms the dielectric of the condenser, so that we again have the case of a circuit containing resistance, self-induction and capacity in series in which an alternating current is generated by a series of impulses of low frequency. It may be well to remark that Edison was one of the first to note the advantage of elevation for the condenser plate, as is shown by his statement in the patent; "that it is necessary on land to increase the elevation in order to reduce to a minimum the induction absorbing effect of houses, trees and elevations in the land itself."

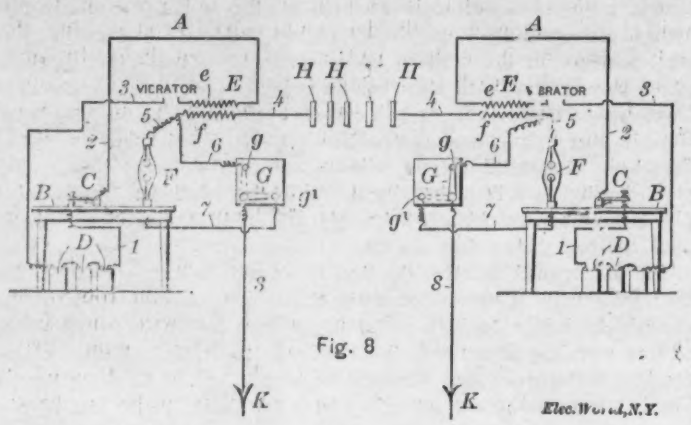


Fig. 8

The patent to Kitsee, which forms the last one of the electrostatic induction series, resembles the Edison patent in many respects, but uses a Geissler or vacuum tube for a receiving instrument. The closing of the key, in sending a current through the wire in which the Geissler tube is intercalated, causes a discharge in the tube which produces a continuous glow as long as the key is depressed. This permits the use of a dot and dash system of telegraphy. Referring to Fig. 8, a wire leads from the earth at K, through the switch G, and then either through the secondary f or through the Geissler tube F, and secondary to the line, according as the switch G is in the transmitting or receiving position. The local or signaling circuits consists of batteries D, a key C, a vibrator and primary e. With the switches in the position shown, on depressing the key C at the right-hand station, the vibrator is started, and the current induced in the secondary f, which alternately charges and discharges the plate H. These charges act inductively on the intermediate plates H, and finally induce a charge on the left-hand plate which creates a current in the secondary f which flows through the Geissler tube F, through the switch G to earth, thus causing a glow in the tube.

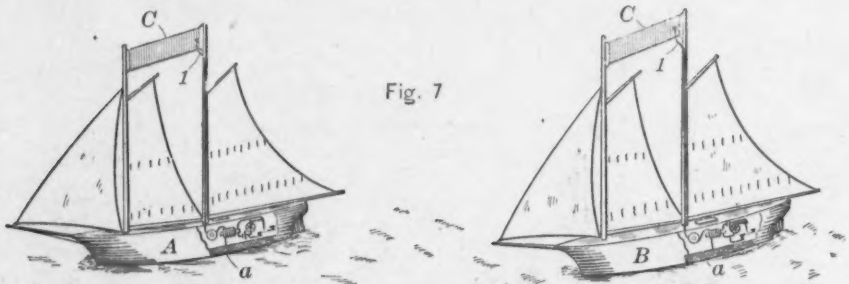


Fig. 7

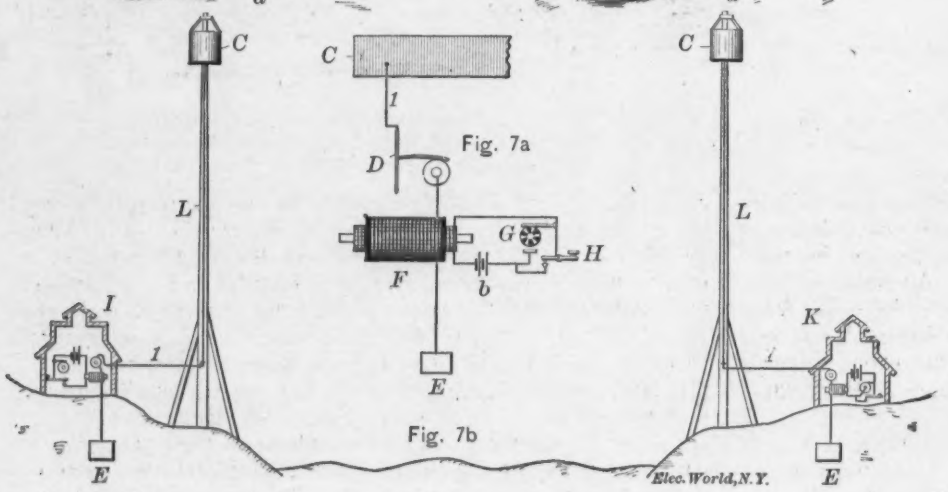


Fig. 7a

Fig. 7b

WAVE METHODS.

It seems difficult at first to separate wave methods from some of the electrostatic systems used by Dolbear, Edison and Kitsee, and indeed both may be regarded as belonging to the same generic class of induction as distinguished from conduction methods. It will serve to bring out the differences that exist between them if we digress somewhat in order to consult the examples furnished by other undulatory fields.

When sound waves are sent through the air, for instance, a great difference is recognized by the ear between a noise like the report of a cannon and a musical note. The former is produced by one or more shocks or sudden impulses, the latter by a series of waves of definite frequency and amplitude.

A similar distinction may be recognized when solid or liquid bodies are set in vibration. If a string is fastened at one end and the other held in the hand a single impulse may be sent along it by jerking the hand to one side, or a series of impulses or waves following each other in definite order, and at a uniform distance apart, may be formed by shaking the string transversely in timed sequence.

It is difficult to imagine an impulse formed by light or heat, for the period of such a wave is so short that a great number of them are sent out before the radian source can be eclipsed. A flash of light, which corresponds in its effect on the retina to the shock produced by a sound impulse or noise upon the tympanum, is ir

reality made up of a great number of waves, and is not due to a single light impulse. The persistence of impressions on the retina, the duration of which is about half a second, permits 250,000,000,000,000 light waves to act upon it before the sensation due to the first wave has died out.

In all these cases an impulse may be regarded as a single wave, but differing in shape and sometimes in velocity from the wave that exists in a train or series of undulations emitted by a suitable source of energy. In the electrical induction methods which have been described a single impulse or a number of them is generated, and these impulses produce their separate effects upon the receiver. One impulse dies out and an interval of time elapses before another is created. Their effect may be cumulative, as in the case of the Kitsee apparatus, where a series of impulses produced by depressing a key causes a continuous glow in the vacuum tube owing to the persistence of the impression on the retina, but the impulses themselves are separated by a distinct interval of time. This will more fully appear from the following considerations.

Suppose, as in the patent to Edison, 465,971, a Rhumkorff coil is used to charge the inducing plate, and assume that the current interrupter G is driven at a speed which will produce 100 breaks of the primary current per second. In each one-hundredth of a second two distinct charges of opposite sign are produced at the end of the open secondary; the one due to the make of the primary, the other to its break. In addition there are a number of oscillations of the make-induced charge as well as of the break charge. The shape of the curve which shows the charge of the ends of the secondary may be roughly indicated as in Fig. 9. This shape depends on a number of conditions, which include the resistance, self-induction and capacity of the two circuits, and is particularly affected by the presence of a condenser in the primary circuit[1]. For the present purpose it is sufficient to say that the curve is made up of two predominant impulses A and B, one positive and the other negative, each accompanied by a few considerable oscillations a and b, with a large number of neglible waves, a' and b', and a period of zero charge C between them. In some experiments by Bernstein[2] the frequency of the oscillation was as high as 20,000 per second. If the interrupter breaks the primary 100 times a second 200 oscillations will have time to die out between two breaks. Only a few of these can be effective owing to the large dampening factor of the circuits, and in the experiments referred to perhaps thirty oscillations were measurable, of which the first two or three alone may be regarded as of the same order of intensity as that of the initially induced wave. In pure wave methods on the contrary each wave of the train exerts its influence and is as effective as any other.

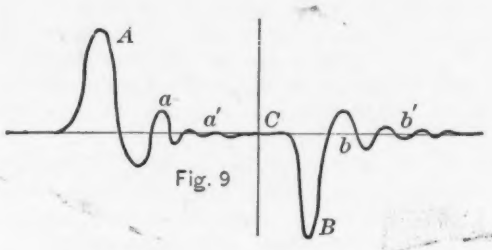


Fig. 9

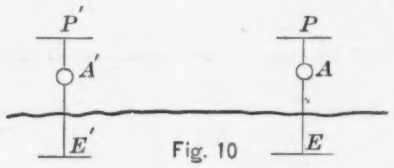


Fig. 10

Another distinction which exists between impulse and wave methods is brought out by the principle of resonance. As is well known an oscillatory disturbance of definite period will exert a much greater effect upon a system tuned to the same period than upon one differing even slightly from it. A train of waves sent out by a sounding body will set a tuning fork of the same pitch into sympathetic vibration, but will leave undisturbed a fork of slightly different pitch.

A pendulum may be made to oscillate through a large arc by a series of weak forces if we so time their application that the interval between them is equal to the period of the pendulum. This has been used in a telephone selective signal system, in which each station is provided with a single pendulum of a definite time of vibration, which is determined by the position of a weight along its length. A number of electromagnets connected in series with a battery are arranged one at each station and each in position to attract its pendulum. Each subscriber can close the magnet circuit in suitable time sequence by means of a make and break pendulum whose period can be made equal to that of the call of any of the subscribers wanted. The magnets are thus all energized at each closure of the circuit, but the pendulum at the call station is the only one that responds, since its period is equal to that of the calling pendulum.

In optics, as is well known, a ray of light of a fixed wave length emitted by the sun will be absorbed by an incandescent gas in its photo sphere, which sends out waves of the same wave length, thus produced a so-called dark line in the solar spectrum. This has enabled physicists to determine the composition of the sun and "fixed" stars.

So an electrical oscillation of a definite period will exert, other conditions being the same, a much greater inductive effect upon one of equal period than upon one differing even slightly from it. The phenomenon of resonance is absent from electrical circuits in which impulses only are produced, for in them there is either an entire absence of period or this is not fixed but variable. Or as Lodge puts it[1], almost anything will respond equally well or equally ill to a dead-beat or strongly damped exciter.

Before proceeding to the discussion of the patents that have been granted for applications of wave methods it will be desirable to consider briefly a suggestion of Tesla which relates to a method of signaling by means of high frequency currents. The scheme, which is illustrated in Fig. 10, is described in his researches edited by T. C. Martin, 1894. Assume that a source of alternating currents of high frequency A be connected with one of its terminals to earth and the other to a body of large surface P When an electrical oscillation is set up at P this acts inductively on P', which constitutes a receiver. At any point within a certain radius of the source A a properly adjusted self-induction and capacity can be set in action by resonance. This method of signaling resembles that of the Edison patent 465,971, but an alternator is used without an induction coil, whose period, if we take for granted that a Tesla generator is referred to, may be as high as 20,000 reversals per second. No coherer is necessary, and the period of the waves emitted by the alternator, which is equal to that of the oscillations created in some of the induction methods described above, is of a much lower order than that of the Marconi and Lodge patents referred to below, in which waves are produced whose frequency may equal 10,000,000 per second. It will be seen that this device occupies an intermediate position in the development of the art.

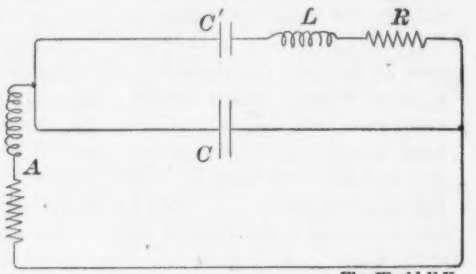


Fig. 10 a

The diagram in Fig. 10a shows the arrangements of the constants of the circuit. The generator A has a given self-induction and resistance; C' denotes the condenser at the receiving station in series with a suitable relay of resistance R and self-induction L. C is the condenser formed by the sending plate with the earth. It is shown as connected across the receiving circuit.

The case may be solved by the geometrical method, if the values of the constants are known. The calculation of the latter is a matter of some difficulty, since alowance must be made for the proximity of the condensing plates to the earth. The formula for calculating the capacity of two parallel plates

$$S = \frac{A}{4\pi d}$$

assumes that the field between them is uniform, which is only true when the distance between the plates is small compared to the distance of the plates from a foreign inducing body. This condition is just the reverse of the present case in which the earth acts inductively on the plate, increasing its capacity. In the absence of any experimental data it will be misleading to calculate a theoretical effect whose value in practice may be very different. Attention is

[1] See Colley, "Wied. Ann.," vol. 280, p. 109, and Lemstrom, "Pogg. Ann.," vol. 147, p. 354.

[2] "Pogg. Ann.," vol. 142, p. 54, 1871.

[1] See "The Work of Herz and Some of His Successes."

called to the fact, however, that the earth condenser C is of much larger capacity than C', so that very little current will be diverted through the receiving circuit. The capacity of the condenser C', moreover, is very minute, so that to secure resonance the self-induction of the circuit must also be made very small according to the formula

$$T = 2\pi\sqrt{LC}.$$

It is impossible to fix the value of self-induction by calculation when its value is so small; a cut-and-try method must be used until the proper length of wire is obtained which will neutralize the capacity.

The method used by Tesla, which has been described, resembles his proposed means for transmitting power at high altitudes, for which British patent 24,421 of 1897, and Swiss patent, 15,542 of 1897, have been granted to him, and is a step in the direction of his recent United States patent, 613,809, November 8, 1898, for controlling the movements and operation of a vessel or vehicle. Although both of these inventions relate to a different art, namely, that of transmitting power as distinguished from that of transmitting signals, yet by reason of their analogy to the present subject matter a brief description of them will be given. In the patent for transmitting power step-up and step-down transformers of high converting power are used, the former at the sending and the latter at the receiving station. One end of the secondary of the step-up transformer is connected to earth, the other to an insulated metallic sphere or condensing surface at a high elevation in the atmosphere. A similar arrangement is adopted at the receiving end and power is transmitted from one condenser plate to the other. The conditions which effect this method of transmission have been pointed out above.

In the patent, No. 613,809, for steering and propelling vessels a coherer circuit is used and local circuits which are energized by storage batteries for controlling the propelling and steering mechanisms. A steering motor is made to run in one direction by a local circuit thrown in by a relay and is driven in the reverse direction by another circuit and relay. The relays are energized by the coherer circuit, which includes a commutator and battery. The coherer circuit is made effective by the oscillator on shore. The boat is put into the water with the rudder to starboard, for example, the oscillator is started, the coherer is put into operation and the local circuit is thrown in which drives the rudder to port. This continues until the rudder reaches the port side. The coherer is then again operated which turns the commutator in the coherer circuit so as to throw in the local circuit which drives the rudder to starboard. The boat is thus made to steer its path in a series of zig zags. Signal lights may be flashed each time the coherer is operated to imitate the course of the vessel.

(To be continued.)

Telephone and Street Railway Systems in Shanghai.

United States Consul-General Goodnow, of Shanghai, has given the following information to the State Department:

The City Council of the city of Shanghai is now advertising for proposals for telephone and electric railway systems. The specifications can be seen at the Council's agency in New York city, or copies can be obtained from the city engineer here for 25 taels each (a Shanghai tael is equal to about 65 cents in gold). Bids on the telephone franchise must be in by March 31, 1899, while bids for the tramway franchise must be in by March 15, 1899.

Shanghai lies on the west bank of the Whangpoo River, about 12 miles from the Yangtze River. The city extends about 3 miles along the river, and from half a mile to 1 mile back from it. It is densely populated, principally by Chinese, the estimated population being over 300 per acre. Negotiations are in progress between the Chinese authorities and the English, French and American consuls-general, whereby it is hoped that such an extension of the settlements will be made that the city will be enlarged to more than three times its present area. The present settlements, three in number, were originally ceded (1845) to the American, English and French Governments for the residences for their citizens, the land being held by the separate owners on perpetual lease from the Emperor. The American and English settlements are in one municipality, governed by a council elected annually by the ratepayers. The French settlement is governed by a council elected by the ratepayers of that settlement. Actions brought against the municipality are tried by a court of consuls, now consisting of the American, English and German consuls-general. In all suits against individuals or companies the defendant is entitled to trial before the court of his own nationality and under its laws. The municipal police and other local regulations are recognized as law by the various consuls. So thoroughly is this a cosmopolitan city that any changes in its regulations must be approved by the entire consular body and the diplomatic body at Pekin before they become operative.

The city is almost perfectly flat, and the average height above high water is about 2 feet. The soil is alluvial. The yearly rainfall is 44.24 inches. The highest temperature ever observed was 102.5° Fahr. in the shade, and the minimum, 10.5° Fahr. Coolie labor is paid about 25 cents Mexican per day, but this cannot be compared with the white labor of the United States for efficiency.

From the foregoing it will be seen that a contractor for city work must deal with the council of the Anglo-American settlement, with that of the French settlement, and with the Chinese authorities for any franchise which is to include all Shanghai and the surrounding country. This fact, and the additional one that the foreigners are divided from the Chinese and from one another by racial and national antagonisms, will make it difficult to obtain any franchise covering the entire city. But the necessities of the case may force the granting of the two franchises in question. There are about 5650 foreigners in the settlements and 410,000 Chinese. There are 200,000 Chinese in the suburbs. The city's income is about 730,000 taels ($474,500), and its debt is 1,131,800 taels ($735,670).

The telephone company in Shanghai operates 338 telephones, charging an annual rental of from 60 to 70 taels. The instruments are of the oldest style and the service is not good; but, as is usual when a company is already in possession, it will have an advantage in the coming competition, knowing the local conditions and the people. The Council proposes to give a thirty years' exclusive franchise, reserving an option to purchase after fifteen years. It requires a deposit of 10,000 taels (about $6,500) with the bid as an evidence of good faith. If good telephones could be furnished at a reasonable rental I believe that many times the present number would be used, for the Chinese seem very partial to electrical appliances. In the matter of cost, the telephone has a sharp competitor in the cheap labor of the country. A coolie can be hired to carry chits (letters) for $5 Mexican ($2.37 gold) per month. With a poor telephone service, the coolie is more reliable and much less wearing on the temper than is the wire. Probably nine-tenths of the messages are carried by coolies at the present time.

The tramway problem is a much more complex one. It is proposed to give a franchise for thirty, forty or fifty years; but the tender accepted by the Council must afterward be ratified by the ratepayers. The specifications fix a maximum first-class fare of 10 Mexican cents and a maximum second-class fare of 5 Mexican cents for transporting passengers from one point to another on the lines. A deposit of £10,000 is required with the bid as an evidence of good faith. About 23 miles of track are to be laid at once. An overhead trolley system, supported by iron poles, is asked for, as it is not thought an underground system is practicable where the water stands so near the surface of the ground. The streets along which the proposed roads are to run are macadamized with broken granite on a foundation of broken brick. There are twelve small bridges which will have to be strengthened.

The details of construction and operation are largely matters of experiment, as there has been no rapid transit in this country; and they should be carefully studied by experts on the ground. An American gets little realizing sense of conditions here by what is written. Everything is so foreign to his ways, ideas, and manners that only the evidence of his eyes will convey a clear conception.

Since the Japan-China war Shanghai has rapidly developed into a manufacturing as well as a distributing centre. Rents and values of real estates have trebled, but wages and profits have not increased proportionally. The immediate need is for means by which the suburban territory can be brought within reach of the business centre. Present methods of locomotion are too slow and expensive to enable the clerk with an average salary to live beyond walking distance from his work. The population here is sufficient to support a tramway system, and the congested condition of the present city will force people to build at once along the proposed lines of railway extension.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE
AMERICAN AND FOREIGN
By Carl Hering

Dynamos, Motors and Transformers.

EFFECT OF COMMUTATION ON THE FIELD OF DYNAMOS.

Some time ago (see "Digest," May 14) Mr. Everett described some experiments on the character of the change of current in an armature coil of a dynamo and motor while that coil was passing under either brush. In a short, illustrated article published in the Lond. "Elec.," Dec. 30, he now gives an account of an investigation of the effect of this change on the field. An exploring coil of ten turns of fine wire was wound on one of the armature coils, with one end connected to a slide ring and the other to a revolving contact-maker, thus enabling the e. m. f. generated in that coil at any instant to be found by the usual method of charging a condenser. In this way he obtained curves, which are reproduced for both motors and dynamos, with an ordinary brush and with a thin brush, the abscissas showing the relative positions of the centre of the exploring coil, while the ordinates represent the voltage induced in it. Broadly speaking, the curve shows that the e. m. f. decreases from its initial negative value under the trailing horn, rapidly at first, then more gradually, to zero; it then increases, slowly at first, and afterward more rapidly, to its final value. The field is found to be affected by the change of current in the coil under the brush, and this effect is repeated at regular intervals corresponding to the distance between the centres of adjacent coils; the presence of that effect is clearly shown in the curves, causing successive ripples, of which the one under the brush is the most marked. When a thin brush is used the ripples in both dynamo and motor curves are much more pronounced with heavy than with light loads, since the current change is greater. The difference between the dynamo curves at various loads is not nearly so great as between the motor curves, and the former are smoother, these results being probably both due to the same cause, namely, that the current and e. m. f. in the coils under the brush are changing in the same direction in the dynamo, but in opposite directions in the motor. With the thicker brush the curves are comparatively smooth in all cases. Any sudden change of current in one of the short-circuited coils is counteracted by a corresponding change in the adjoining coil; the field is therefore steadier and the e. m. f. curve smoother, with the thicker brush. —Everett. Lond. "Elec.," Dec. 30.

STARTING SINGLE-PHASE MOTORS.

Several answers to a request to describe what method should be used for starting single-phase, alternating-current motors so that they may be run from public lighting mains without causing disturbances, are published in the Lond. "Elec. Eng.," Dec. 30. One correspondent classifies such motors into continuous-field, alternating-field and induction motors, discussing each separately. Continuous-field motors are necessarily synchronous, and must be run up to speed before they can be switched on to the circuit; they must always start on a loose pulley. If the motor is coupled directly to its exciter a battery of small capacity may be used, driving this exciter as a motor. Or the field coils, if of the revolving type, may be connected to a two-part commutator on a shaft, and the motor can then be started by putting a resistance in series with the field and the armature in parallel with it, the brushes being shifted forward through 90° and then moved back as the normal speed is approached. When synchronism is attained the resistance is cut out and the field put in parallel with one armature coil, when the motor will go into step. Alternating-field motors are unstable except in very small sizes, and are started through resistances in the usual way. Induction motors are the most successful, being self-starting under considerable load if excited by polyphase currents. The best method of starting is to put a non-inductive resistance in series with the rotating part, its best value being such as will make the total resistance of the circuit less than 2 by 3.14 by $n\ L$, in which L is the self-induction of the circuit and n the frequency of the current from the mains; it must be given a slight start by pulling on the belt. The insertion of resistance as described is very effective, as it not only reduces the large wattless current but brings the stator and rotor currents more into phase, thus increasing the starting torque. It also dispenses with the auxiliary starting coil and the induction coil or condenser necessary to produce a di-phase current in the stator. The starting current is also less than when the split-phase method is used.—Lond. "Elec. Eng,," Dec. 30.

REFERENCES.

Current Density in a Rotary Converter.—Several brief descriptions showing how to calculate the current density per square inch of cross-section of area of the armature conductors, in a rotary converter.—Lond. "Elec. Eng.," Dec. 30.

Revolving Field Motors.—In this continuation of his long theoretical series of articles the author discusses the calculation of the dimensions of non-synchronous polyphase motors.—Hanappe. "L'Eclairage Elec.," Dec. 24.

Starting Induction Motors.—In the present portion of the long serial on the care of electrical machinery the author describes the starting devices of single-phase induction motors.—Baxter. "Power," Jan.

Design of Small Motors.—An illustrated description of how to design a 1-hp bipolar motor with a drum armature.—Poole. "Amer. Elec.," Jan.

Synchronous and Induction Motors.—One of the series of articles in which the author describes some of the properties of such motors, including some curves.—Berg. "Amer. Elec.," Jan.

Counter e. m. f. of Motors.—A brief description of experiments to give students a clear idea of the nature of the counter e. m. f. of motors.—McKissick. "Amer. Elec.," Jan.

Field Windings of Dynamos.—An elementary article describing the various methods.—Rice. "Amer. Elec.," Jan.

Lights and Lighting.

ENCLOSED ARC.

The relations between the length of the arc, the voltage and the current when the e. m. f. remains constant have been investigated by Mr. Lori when the arc is of the enclosed type, the results being given in "L'Elettricita," Nov., and abstracted briefly in "L'Eclairage Elec.," Dec. 24. The character of the arc depends on the form and dimensions of the globe enclosing it, and in the present experiments he therefore used a cylindrical globe 7 cm in diameter and 20 cm in height, this being about the size generally used. The method was the same as that employed by Mrs. Ayrton in her well-known researches, and the results obtained conform with those obtained by her. The relation between the difference of potential and the length of the arc for a given current can be represented with sufficient accuracy by a straight line. In order to compare the free arc with the enclosed arc he shows, on the same diagram, the straight lines for both kinds, at different currents. From these it appears that with the enclosed arc a greater variation of the voltage can be used than with free arcs. The increase in the voltage corresponding to a given increase of the length of the enclosed arc is generally greater than that for the free arcs. For small currents the voltage of the enclosed arc is appreciably higher than that for the free arc, and for strong currents it is only slightly less.—Lori. "L'Elettricita," Nov.; abstracted briefly in "L'Eclairage Elec.," Dec. 24.

REFERENCES.

Lighting a Museum.—The lighting of the Manchester Museum, described in the Lond. "Elec. Rev.," Dec. 30, is of interest because the inverted arc light is adopted in some places with great success, and because the current is supplied from the five-wire system used in that city. The incandescent circuits are wired for 200 volts, and for the purpose of balancing, the ground floor lighting is divided into two main circuits of eight arc lamps each; a diagram of the complete system is shown.—Lond. "Elec. Rev.," Dec. 30.

Transformer for Series Lighting.—A brief, illustrated description of a system in use for operating street lights from a 350-volt and 700-volt two-phase machine until midnight, and then by the use of a double-throw switch and a terminal change switch they are connested to a 1,000-volt alternator.—Hunter. "Amer. Elec.," Jan.

Train Lighting.—A translation in abstract into French, with a diagram, of the article describing the Dick system, noticed in the "Digest" Aug. 6.—"L'Eclairage Elec.," Dec. 24.

Theatre Lighting.—A brief description of the electrical installation of the new theatre at Kennington.—Lond. "Elec.," Dec. 30.

Power.

UNDERGROUND PUMPING INSTALLATION.

A well-illustrated description by Mr. Lasche is given in the "Elek. Anz.," Dec. 25, of an 800-hp pumping plant, the large motor and pump for which are located 1500 feet underground. The generator is a three-phase machine of the inductor type, generating 2000 volts, connected by the triangle system, delivering, with a motor load, 650 kilowatts. The frequency is 25. In spite of the high voltage the armature windings consist of bars insulated with artificial mica. In order to make repairs in these bars the stationary part is so mounted that its supports may be removed, so that it rests on the revolving part, and by turning this through a half revolution the lower part, which is ordinarily in a pit, can be brought uppermost. (It does not seem clear why the apparently simpler method of making the pit accessible was not used.) The exciter of the dynamo is driven by a separate machine, because it is required by the method of starting used, in which the dynamo must be fully excited at the start. The installation in the underground pumping chamber is extremely simple, as it contains neither switches nor measuring instruments; the use of short-circuited armatures also enables the apparatus at the generating station to be very simple. The motor has an output of 750 kilowatts, and runs at a speed of 180 revolutions, the armature being also wound with bars, it being of the short-circuited type. Owing to the slow speed required by the pumps, the power is transmitted from the motor by means of ropes. The builders have, however, made a change in the design of several similar underground stations, in which the motor is made the fly-wheel of the pumps, operating the latter through cranks. Such a combined motor and pump is illustrated, for a speed of 200 and a power of 120 horse-power.

(The method of starting the motor of the above-mentioned plant is not described, but presumably the dynamo and motor are electrically connected while at rest, the motor therefore starting with the dynamo, the latter being fully excited at the start.)—Lasche. "Elek. Anz.," Dec. 25.

ELECTRICITY IN MINING IN 1898.

In a short article in the "Eng. and Min. Jour.," Jan. 7, forming one of a number in the past year, the great extent to which electricity is being used in mining is pointed out. Direct-current systems do not meet the requirements, as was expected, even though the direct-current motor was as perfect a machine as could be manufactured. In the introduction of the multiphase system and the induction motors, many of the principal difficulties disappeared. "The prediction of electricity as the universal motive power seems warrantable if based on figures obtainable." New plants have been constructed in many mines during the past year, including coal-cutting plants of all descriptions, haulage plants, hoisting and pumping, etc. Probably the most important extension has been for the production of bituminous coal, the best machines for which are those of the undercutting type. In the metal mines of the Western States electrical power has also made rapid advances. Many water powers have been utilized for transmitting powers to the mills. The peculiar advantages of a central power station in a district where there are many small mines have been utilized in many instances. An important development during the year was in the use of electric power for the haulage in coal and other mines. Some new electric locomotives have been introduced and found much acceptance. No new developments have been made in the use of electricity for drilling, the defects of the electric drill being apparently inherent, and have not been overcome; in this branch of work compressed air has fully maintained its superiority. One of the most successful plants installed during the past year was that of the Colorado Power Company, furnishing power to the Cripple Creek mines. It will not be long before the great majority of mines take their power from this station.—"Eng. and Min. Jour.," Jan. 7.

POWER FROM BLAST FURNACE GAS.

The subject of the utilization of blast-furnace gases which now go to waste seems to be receiving more attention. In a recent paper by H. Allen before an institution of iron and steel works managers, abstracted briefly in the Lond. "Elec. Rev.," Dec. 30, he gives some interesting information. In no furnaces, he says, is the gas so poor that it will not burn satisfactorily in the gas engine; moreover, the composition of the gas is said to be exceedingly uniform, and it is a safe gas for large cylinders and large power units. One cubic foot of the gas represents 22,372 foot pounds of work, and yet it is thrown away in large volumes. When utilized under steam boilers, as is sometimes the case, it does not develop one-fourth of the power which it will develop in the gas engine. The Thwaite-Gardner system of utilizing these gases, which he describes, is in use at two English iron works, and is to be introduced into others; a plant has just been completed in Germany for making calcium carbide, a 180-hp engine being used. It will run on about 100 cubic feet per indicated hp hour, which is equivalent to about 1.3 pounds of coke charged into the furnace, a result which is said to be remarkable. If Germany is going to use her blast-furnace gas in this way, fear is expressed for the English ironmasters.—Allen. Lond. "Elec. Rev.," Dec. 30.

REFERENCES.

Constant Speed Regulation.—A short, illustrated description of a peculiarly constructed pulley, which will diminish in diameter when the normal load is suddenly increased, thereby increasing the speed of the armature and maintaining the proper voltage.—Coleman. "Amer. Elec.," Jan.

Distribution of Alternating Currents.—In this, the concluding portion of his long article (see "Digest" last week), he discusses the equipment of sub-stations and the distribution mains. The article consists of practical hints.—Ewing. Lond. "Elec. Eng.," Dec. 30.

Electricity in Refrigeration.—An illustrated article describing the plant recently installed for a refrigerating company in New York city, the lighting, ventilating, elevating, power and partial pumping service for which is electrical.—"Amer. Elec.," Jan.

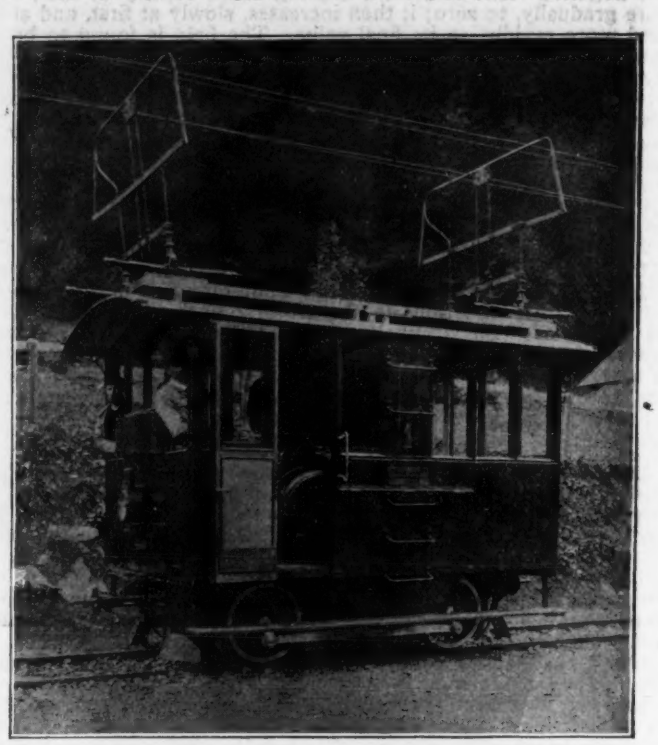
Transmission and Distribution by Alternating Current.—In this continuation of his long article the author discusses the excitation and its regulation, with the aid of illustrations.—Leblanc. "L'Eclairage Elec.," Dec. 24.

Stage Appliances.—An illustrated description of the movable stage of the Drury Lane Theatre mentioned in the "Digest" last week.—Lond. "Elec.," Dec. 30.

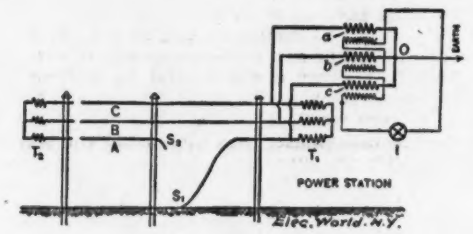
Traction.

THREE-PHASE RAILWAY FROM STANSSTADT TO ENGELBERG.

An interesting and well-illustrated description of one of the latest of the three-phase lines in Switzerland, which runs from Stansstadt to Engelberg, is given in the "St. R'y Jour." and "Amer. Elec." for Jan. One of the features of interest is that part of it is on a 25 per cent. grade. For a distance of 11.2 miles the traction is accomplished by adhesion, but for a distance of a short mile the roadbed is furnished with a rack-rail and on this the grade averages 25 per cent. On the portions on which the grade is less the cars are operated as simple motor cars, capable of drawing a trailer, but at the foot of the steep incline an electric locomotive is run behind the motor-car, pushing the latter to the top of the grade, after which the motor-car again proceeds alone. The speed of the cars is absolutely constant, namely, 12 miles per hour over the long portion and 3 miles on the incline. This has the advantage that the motorman is not able to waste current by lack of judgment and to take liberties with the running schedule, the manipulation being confined to the starting. The power house is at the foot of the incline, and contains two three-phase generators of 200 horse-power each, driven by turbines and separately excited by means of a small turbine. The voltage is 750, and the frequency 35. For the distant section the voltage is stepped up to 5000 and then lowered again at a point 6.9 miles distant. The rolling stock is composed of two electric locomotives, five motor cars and four freight cars; the locomotives have a weight of 16.5 tons, and besides operating the cars on the incline they also handle the freight trains. They have two axles and are equipped with two motors of 75 horse-power each, driving the rack gear with a double reduction gearing, but this can be disconnected, and then they run at a speed of 8 miles per hour by adhesion. The locomotives require an average of 95 to 100 amperes on the incline. When descending, attached to the front of the car, the locomotives furnish a current of 60 to 65 amperes, and as this is generally greater than that used by the other trains on the line, the surplus is absorbed at the station by means of a water rheostat. The contact is made with an overhead wire, by means of two sliding bows, composed of long cylinders of aluminum separated from each other by a piece of wood



soaked in paraffin, as shown in the adjoining illustration; this avoids the difficulties of construction with overhead frogs, which are not desirable when two trolleys are used. Another interesting feature is the device to prevent accidents by the breaking of wires carrying the 5000-volt circuit. This arrangement is shown in the adjoining figure; *a*, *b* and *c* are the primary coils of three small transformers,



which are connected to the high-tension circuit where they leave the station; they are connected to a common point *o*, which is grounded. The secondary circuits of these transformers is connected in series to a single circuit containing the apparatus *I*, which interrupts the primary circuit and is an arc lamp; the secondary voltage of these transformers is 50. When there is no broken wire there is an equilibrium of the entire system, and there will be no current in the secondaries, but when one of the wires is broken the unbalancing produces a secondary current which operates the interrupter in from four to seven seconds.—"St. R'y Jour.," and "Amer. Elec.," Jan.

HIGH-SPEED RAILWAY NEAR DUESSELDORF.

A description of this road, which has a length of about 13 miles, is given in the Int. Ed. of the "St. Ry. Jour.," Jan. The power station contains three units of 300 horse-power each and a storage bat-

tery of 200 ampere hours at the station, there being a similar one about 9 miles distant, which is charged by two boosters of 22 kilowatts; the line voltage is 600, and each car is operated by two gearless motors of 75 horse-power.—Int. Ed. "St. Ry. Jour.," Jan.

INTERURBAN RAILWAYS AROUND DETROIT.

A description of this system of interurban electric railways, which is said to be one of the most extensive in the country, is given in the "St Ry. Jour.," Jan. Five or six interurban railways of 20 to 40 miles in length radiate from the city, while in the city the cars travel over the local street-railway tracks. The speed in the country is 35 to 40 miles an hour, and all of the lines carry some freight. The voltage is from 600 to 650, several of the lines using boosters, but none of them the alternating current. The cars are large and have four motors of 50 horse-power or two of 75; some of them have two trolley poles, as the current with the heaviest cars averages 150 amperes when running on the level. Each car makes about 300 miles per day.—"St. Ry. Jour.," Jan.

ELECTRIC RAILWAYS IN AUSTRIA.

Some of the newly opened electric railways in Austria are described in an article by Mr. Ziffer in the January number of the "St. Ry. Jour." The Poestlingberg line, near Linz, has a length of about a mile and three-quarters, and a gauge of one metre; average grade is from 10 to 10.5 per cent., and the track is depended upon for adhesion, there being no rack. One of the features of interest is the method of emergency brake, the cars being equipped not only with the ordinary hand brake, but also with jaws which fit around the head of the track rail; in an emergency these jaws can be screwed together, grasping the head of the rail, the shape of which is such as to permit this, the fishplates being arranged accordingly. The other road described is the Praterstern-Kagran Railway, a small line operating six cars.—Ziffer. "St. Ry. Jour.," Jan. Int. Ed.

SURFACE CONTACT SYSTEM.

The Campbell system is briefly described and illustrated in the N. Y. "Elec. Eng.," Jan. 5. There is a shallow conduit, which is completely enclosed and is water-tight. The upper portion is connected to section rails, which are on the level of the street, and the lower portion contains the live conductor. A little traveler rolls on the bottom of this conduit, and is attracted by magnets carried beneath the car, the traveler thereby connecting the bottom of the conduit with the top, thus making the section underneath the car alive. Nothing is said about the possibility of the traveler being lost by the car, except that in a series of experiments it was found impossible to lose the traveler. The car carries a few storage batteries to hold the traveler in case the main circuit is broken.

GLASGOW.

A report to the Glasgow Corporation Tramways by the general manager, John Young, is given in the "St. Ry. Jour.," Jan. At present there is only a short section of line operated by electricity, but there appears to be a saving in the working expenses of about 4 cents per car mile over horse traction. He makes an estimate of the relative cost of equipping 37 miles of double-track road for the overhead electric system and also for the conduit system; the latter is about double that of the former. His general recommendation is that important extensions be made in the overhead system, and that experiments with the conduit be left for another time.—"St. Ry. Jour.," Jan.

VIENNA.

The mixed trolley and accumulator system appears to be meeting with some favor in Europe. A line constructed according to this system in Vienna, known as the Ringstrasse-Prater Railway, is described in the international edition of the "St. Ry. Jour.," Jan. The batteries are carried under the seats, and are provided with ventilating apparatus leading to funnels at the top of the car. The rails weigh 41 kg per metre; the feeders are all underground; the poles are all Mannesman steel tubes, and span wire is used throughout, sheets of india rubber being laid under rosettes to reduce the sound. There are 25 cars in operation.—Int. Ed. "St. Ry. Jour.," Jan.

ELECTRIC RAILWAYS IN ITALY.

A review of the tramway stations in that country. The author states that while Italy has not made the same advances as some other countries, there is an excellent field, on account of the large amount of water power. Milan leads the rest of the country in the number of railways and the length of lines.—Semenza. "St. Ry. Jour.," Int. Ed., Jan.

PROPOSED RAILWAY IN MOSCOW.

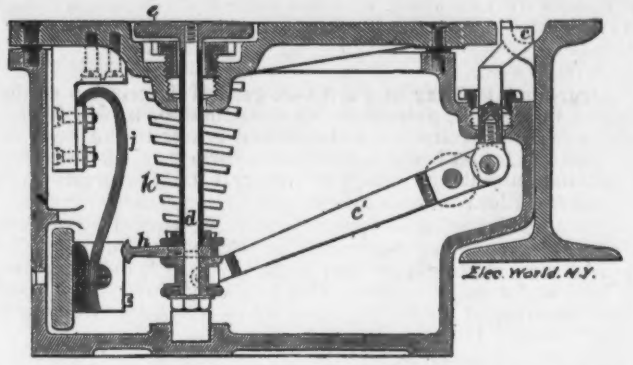
A description of a proposed scheme for an extended system of electric railways in that city, the total length of which is to be about 60 miles. The trolley system is to be used in most parts of the city, while in the others either the storage battery or the surface-contact system is recommended.—St. Ry. Jour., Jan.

ARLBERG RAILWAY.

A note stating that it is said that this Austrian railway, which runs from Innsbruck to the Swiss frontier, is to be worked by electricity, and that three electric firms have jointly undertaken the work for the whole distance.—Lond. "Elec. Eng.," Dec. 30.

SURFACE CONTACT SYSTEM.

A purely mechanical system of operating the surface contacts is described in the Lond. "Elec. Rev.," Dec. 30, and known as the Allen and Peard system. One of the contact boxes is shown in the adjoining figure. As will be seen, the car-wheel presses the end of a lever, which then raises the contact plate above the surface of the street; the plate is then gripped and supported by a special form of collecting device carried under the car, in which the contact plate slides and finally drops back into its seat after the car has passed; the plate is still further raised by means of this collector, and it is only then that it becomes alive. It is claimed that it is impossible for the lever to be operated by any other means than the wheel of



the car, partly because the groove in the rail is narrow, and because a considerable weight is required. The box is so arranged that it can be removed and replaced by a new interior in the course of a few minutes, if anything should happen to it. The car may, of course, be run in either direction. It is claimed that such a line could be constructed at a less cost than a first-class trolley line. No trial track has yet been erected.—Lond. "Elec. Rev.," Dec. 30.

MAPPING RAILWAY FEEDERS.

What appears to be a very convenient way of mapping the feeders of an extended electric railway system is described by Mr. Dexter in the "St. Ry. Jour.," Jan., and is accompanied by a map of the feeders of the Nassau Electric Railroad Company in Brooklyn, in which one million pounds of copper was used, delivering at full load about 7000 amperes and including about 100 miles of trolley wires. In this system each feeder is represented by straight lines, all parallel to a common base; lines on the same poles are drawn closely together. The lengths of those lines are laid off according to a convenient scale of lengths at the bottom of the map. Turns are indicated by offsetting these parallel lines to a slight distance above or below, according as the turn is to the left or to the right, but the amount of the offset is not included in the total length, as the offset line begins directly above or below the end of the previous portion, the two ends being connected by a curved line to aid the eye. By thus mapping as parallel all streets traversed by the feeders and omitting all others, much is gained in compactness and the scale may therefore be greatly increased. The name of each street is written above the respective portion. Besides the scale of lengths there are two other scales, one giving the quotient of the volts' drop multiplied by the circular mils, divided by the amperes delivered, as at every point of the line there is a definite relation between the current flowing, the drop from the station at that point, and the size of the conductors. If at any point two of the terms involved are known, the third may readily be determined. The third scale gives the number of amperes delivered with a drop of 50 volts by each one million circular mils, and this is more convenient than the other scale when it is desired to find the current delivered with a specified drop.—Dexter. "St. Ry. Jour.," Jan.

REPAIR SHOP PRACTICE OF THE PHILADELPHIA LINES.

A brief description of the practice adopted by the large system of lines in Philadelphia is described in the "St. Ry. Jour.," Jan. The superintendent of the overhead line department supplies the emergency men with small drawings of the different sections of the line showing the arrangement of the feeders; those from the first station are Nos. 1 to 199, for the second station from 200 to 299, and so on. All the feed wires are carried underground, covering a system of over 1000 miles, including the telephone and return feeder wires. Where the cables enter the power house they are systematically arranged, as shown by illustrations. An emergency system for repairing the overhead line, similar to a fire-alarm service, is in use, the company having about 100 different telephones connecting the emergency stations, power houses and car houses, connection being also made to the city fire-alarm signals, so that whenever there is a fire in the city the repair wagon is sent there at once.—"St. Ry. Jour.," Jan.

HILL-CLIMBING MOTOR VEHICLE TESTS.

In November the French Automobile Club carried out some interesting hill-climbing tests near Paris, an account of which is given by Farman in "Industries" and is abstracted briefly in the Lond "Elec. Rev.," Dec. 30, the slope of the hill varying up to 11 per cent., or 1 in 9, and the length being about a mile. The winner was an electric carriage made by Jenatzy, which covered the distance in 3 minutes and 52 seconds. The total weight of the vehicle was 3960 pounds, and over 28 horse-power was developed in places; the speed was nearly an average of 30 km per hour.—Lond. "Elec. Rev.," Dec. 30.

CANAL HAULAGE.

According to the Lond. "Elec. Rev.," Dec. 30, it has been definitely decided to establish a system of canal haulage on the canal between Brussels and Seneffe.—Lond. "Elec. Rev.," Dec. 30.

REFERENCES.

Reversible Rails.—A recommendation to use a double-headed rail which can be reversed after it is worn. The principal objection which formerly was made, that the base wears where it was held in the iron chair, is claimed to be overcome when the rails are laid on wooden ties or embedded in concrete. Several suggested cross-sections are shown.—Chance. "St. Ry. Jour.," Jan.

Underground Railway in Paris.—A general description of the installation in Paris at present under construction, in which the Orleans Railroad is prolonged underground nearer to the heart of the city, electric traction being used on this portion. It is thought that the installation will be ready at the end of the present year.—"L'Eclairage Elec.," Dec. 24.

Dublin Power Station.—Illustrations, accompanied by a brief description, of the railway power station in Dublin, Ireland, which is said to be the most important street-railway system in Great Britain; it is now under construction. The length of lines to be operated is about 60 miles of double track, on all of which electricity is to be used.—"Power," Jan.

Trolley Wheel for High Speeds.—An illustrated description of the one used on the New York, New Haven & Hartford Railway, designed for high speeds with heavy currents. It has steel flanges one-eighth inch thick, and the tread can easily be replaced when worn out.—"St. Ry. Jour.," Jan.

Union Loop Power House.—A brief, illustrated description of this power house in Chicago. One of the features is the large factor of safety, the reserve being 50 per cent. above the greatest demand, and another is the double-deck design of the building.—"West. Elec.," Jan. 7.

New York City.—An illustration of the mammoth generating plant of the Third Avenue Railroad, recently referred to in The Elec. World, which will be the largest power house ever projected, containing 16 units of 3000 kilowatts each.—"Elec. Eng.," Jan. 5.

Overhead Construction in Liverpool.—Diagrams showing the arrangement of the span wires at a certain place where the work had to be very tasteful, and where all unnecessary overhead wires had to be avoided.—"St. Ry. Jour.," Int. Ed., Jan.

Convertible Car.—A suggestion for a car with longitudinal seats, which is enclosed in winter, and with cross seats when used open in summer; there are doors at the sides and ends.—Clarkson. "St. Ry. Jour.," Jan.

Cork.—An illustrated, technical description of this railway plant, a brief description of which was given in the "Digest" Jan. 14.—"St. Ry. Jour.," Jan.

Armature Rest.—An illustrated description of a simple rest for supporting armatures while repairs are being made.—"St. Ry. Jour.," Jan.

Electric Railway Practice.—A short article on car equipments.—Munroe. "Amer. Elec.," Jan.

Installations, Systems and Appliances.

COMBINED TRACTION AND LIGHTING STATIONS.

The much-talked-of question of the advisability of combining lighting stations and railway power houses is discussed in a long editorial in the Lond. "Elec.," Dec. 23, with special reference to the station at Cork, a railway power house which is also to generate current for lighting, and the Carlisle station, which is essentially a lighting station, with arrangements for providing power for railways in the future; both these stations have just been described in that journal (see "Digest," Jan. 14, and this week). It has been claimed that it would pay a lighting station to undertake electric traction, but that it would not be profitable for a railway power house to supply current for lighting, the reason being that the railway load is fairly uniform over many hours, and therefore highly remunerative, while the lighting load is not. It has also been claimed that the ordinary traffic puts a railway peak on the station at about the same time that the lighting peak occurs, and that, therefore, the combination is not an advantage; but this view is thought to be largely imaginary, as the railway peak is not nearly as large in proportion to the average load as the lighting peak, and in most cases a railway load from morning to night would improve the load factor of the lighting station considerably. The question of a lighting load on a power station may be considered in various ways; the railway company with an extensive network and frequent service of cars would generally have a sufficiently uniform load, and there is certainly no advantage, and, in fact, a positive disadvantage, for such a company to supply a lighting current; but there are many places where the tramway load would be a maximum during the daylight hours, falling after dark, and in such cases a lighting load would increase the profits. When a municipality owns and operates both the lighting and railway plants, it would in most cases be far more advantageous to erect one combined station. Having decided on a combined station, many questions of detail must be settled. The small magnitude of the load on combined stations in that country would render it inadvisable to combine the loads on the steam generators. The more recently designed stations are arranged so that the generators may be switched onto either of the circuits, each of which has its separate section of the switchboard.—Lond. "Elec.," Dec. 23.

PEOPLE'S LIGHT AND POWER COMPANY OF NEW JERSEY.

A very long, profusely illustrated article by Mr. Loewenthal, describing the several stations of this company, is given in the N. Y. "Elec. Eng.," Jan. 5. This company is claimed to have demonstrated beyond a doubt that it is feasible and advisable to furnish current from a central station to a large number of municipalities; in the entire territory which it supplies, and which covers two entire counties with a population of about 600,000, there are in existence less than a dozen isolated plants. The district covered extends west from Jersey City over a large area, including Newark and the Oranges. Special attention is given to the description of the new river station at Newark. There are three generating stations, one in Newark, one in Jersey City and one in Orange, the total capacity of these being 5450 arc lights, 70,000 incandescents and 1700 kilowatts in power, or at the rate of ten incandescent lamps to one arc, and twenty to one kilowatt; this amounts to a total of 158,500 "units" (meaning incandescent lamps).—Loewenthal. N. Y. "Elec. Eng.," Jan. 5.

CARLISLE.

A well-illustrated description of this English electric light station, which will shortly be put into operation, is published in the Lond. "Elec.," Dec. 23; it is of special interest because it was designed by Professor Kennedy. At present it is to be used only for lighting, but in the future the electric railway is also to be supplied with current from the same station. The three-wire system, with an earthed middle wire and 460 volts between the outers, will be used. There is a battery, and the balancing dynamos are to be steam-driven; the booster can be used to add to the voltage of the dynamo during charge or to the voltage of the cells during discharge. During light loads the voltage will be regulated by cutting cells in and out, the cell-regulating switch being interlocked with the booster switch, so as to provide against errors of the attendant. Another exceptional feature is the provision for utilizing the dynamos either for the 560,-volt lighting network or for the contemplated 500-volt railway circuit; for the former they are used as shunt machines, while for the latter they are run as compound machines. The arc lamps used for lighting are connected ten in series across the 460-volt mains. The switchboard is described with the aid of a good diagram of connections. There is also a series of diagrams of the battery-regulating switch, showing the method of using the booster in charging and discharging the battery.

REFERENCES.

Eccles.—A brief description of this lighting station is given in the Lond. "Elec.," Dec. 30; it has a capacity of about 5000 lamps of 8 candle-power. The engines are coupled directly with two alternators of 120 kilowatts each; as the load drops the spare power will be utilized in charging a battery of sixty-five cells of accumulators, having a capacity of 1600 ampere hours, the alternator being run as a motor from the mains to drive the direct-current machine as a generator for this purpose. There is a 25-kw motor alternator to take the night load and act as a reserve.—Lond. "Elec. Rev.," Dec. 30.

Continental Central Stations.—In the conclusion of the long, well-written article on the German company formerly known as the Schuckert Company, the stations at Aix-les-Chapelle, Budapest, Nuremberg, Munich and several other places, all constructed by this company, are described and some of the apparatus is illustrated. In conclusion some remarks are made on the social features of that company, as its success is partly due to the policy of making the employees take a direct interest in the affairs of the company.—Lond. "Engineering," Dec. 30.

Wilmington.—A brief description of additions to this lighting plant, consisting of a storage battery and other improvements.—"Amer. Elec.," Jan.

Jamaica.—A brief, illustrated description of the American Light and Power Plant in Jamaica, West Indies.—N. Y. "Elec. Eng.," Jan. 5.

General Meter Practice.—A short article on the practical management of a modern meter department.—L. C. Reed. "Amer. Elec.," Jan.

Switchboards.—Hints concerning the construction of light and power switchboards.—Sharpstein. "Amer. Elec.," Jan.

Wires, Wiring and Conduits.

CONDUCTORS FOR THE THREE-WIRE SYSTEM.

What the saving of copper really is in the three-wire system is a matter about which there has been some confusion, the reason for which is that there are two ways of considering the matter; one is that there is an equal drop of potential along the lines in the three-wire and the two-wire systems, and the other is that there is an equal percentage of drop; the size of the wire will be different in the two cases. This is explained by Mr. Donner in the "Amer. Elec.," Jan.—Donner. "Amer. Elec.," Jan.

Electro-Physics and Magnetism.

REFERENCES.

Arcs and Non-Arcing Metals.—A short article on the properties of arcs between various materials and on the desired properties of these materials in order to produce no arcs.—Hanchett. "Amer. Elec.," Jan.

Roentgen Rays.—A reprint of the long abstract of the author's paper which was noticed in the "Digest" Nov. 19.—Roentgen. N. Y. "Elec. Eng.," Jan. 5.

Electro-Chemistry and Batteries.

MINERAL PRODUCTION OF THE UNITED STATES.

Almost the entire issue of the "Eng. and Min. Jour.," Jan. 7, is devoted to a series of short articles on the mineral and metal pro-

duction of the United States in 1898, some parts of which are of special interest to electrical engineers. The tabulated summary is only a preliminary statement subject to revision. The production of aluminum was 2600 tons, valued at $1,690,000, as against 2000 tons, valued at $1,400,000, in 1897; the production of this metal continues to be made by one company. The production of copper reached the total of 546,367,793 pounds, an increase of 36,177,074 pounds over 1897. This is nearly two-thirds of the copper production of the world. The exports reached about 56 per cent. of our product. The demand for copper, both at home and in Europe, continued very heavy during the year, and prices increased steadily. The production of carborundum is estimated at 795 short tons, the average value being $200 per ton, as against 621 short tons, averaged at $247 per ton, in 1897. This material is no longer used entirely as an abrasive, considerable quantities being consumed in steel-making as a substitute for ferro-silicon. There is only one producer in the United States, the works being at Niagara Falls.—In a short article by Hunt on aluminum he states that the direction in which larger amounts of aluminum have been used in the past year are its use for electrical conductors and for a metal to replace brass and zinc for many of the common purposes. During the year it was sold in the form of sheets at prices which made it 10 per cent. cheaper than brass sheets for a given purpose, and 35 per cent. cheaper than copper sheets. It was not as cheap as zinc sheets, but for many purposes it is better than zinc, and is therefore being found to be economical. The amount used for electrical conductors during the past season has been fully 660 tons. The total production was 2600 short tons, and arrangements are now being made to increase the Niagara Falls plant to about double its capacity. For electrical conductors the prices of aluminum in the form of bars, plates, sheets and wire has been between 28 and 29 cents per pound at the point of consumption, according to the size of the order. —In a short article on carborundum by Acheson, he states that the price has been still further reduced during the year to 10 to 12 cents for the grain product, that for the powders remaining at 8 cents; about three-quarters of the production was in grains and the remainder in powders. The vitrified grinding wheels are now made successfully, the bond being porcelain, which is reduced to a small amount, some iron being also added, which causes a direct union between the porcelain and carborundum particles. Paper and cloth covered with carborundum was also produced during the past year. Experiments to utilize the amorphous variety as a refractory lining for furnaces have been very successful.—"Eng. and Min. Jour.," Jan. 7.

ELECTROLYTIC COPPER INDUSTRY.

Periodic reports, giving interesting summaries of the state of various industries, are published in Lond. "Engineering," the one in the issue of Dec. 30 being on the electrolytic copper industry. Since the last report on this subject a year and a half ago, there has been a steady growth of this industry, due to the increased demand for pure copper for electrical purposes. Some tables give the figure for the production and consumption of copper for the four years preceding the last; the estimated production of electrolytic copper in America in 1897 was 130,000 tons, while in Europe it was only 30,000. The improvements since the last report relate chiefly to the circulation and purification of the electrolyte and to the current density used. The use of air jets in the vats seems likely to become general, as it not only improves the circulation but oxidizes the impurities. Twenty amperes per square foot is now used in the American refineries. In Widnes, Great Britain, a smooth coating was obtained on a rotating cathode at 38 amperes per square foot. Graham's researches (duly noticed in the "Digest" about a year ago) prove that under certain conditions (the chief one being very rapid circulation) the current density of 190 amperes per square foot may be used without interfering with the physical character of the deposit. It has been recommended to work up the impure electrolyte for copper sulphate at intervals, charging the vats with the fresh solution. Frequent aeration of the electrolyte, followed by filtration, tends to keep it in a satisfactory condition for a longer time. The wet processes for the extraction of copper from the ore, which at first gave disappointing results, are now being used in several places in Germany and Italy, but with what success is not stated.—Lond. "Engineering," Dec. 30.

REMOVING SCALE FROM IRON.

Mr. Cowper-Coles, who is an authority on electrolytic processes, describes an electrolytic method of removing mill scale and magnetic oxide from iron, in the Lond. "Engineering," Dec. 30. After describing the usual pickling process, he states that the early experiments with the electrolytic process, in which the iron to be pickled was made the anode in an acid bath, was found to pit the plates; to overcome this difficulty the current was periodically reversed. A tank for this process is illustrated and described. To quicken the process, the solution should be heated, which is done by lead pipes through which steam passes. There is a removable tray at the bottom, which catches the heavy scale, enabling it to be removed in order to prevent unnecessary consumption of the acid. Another method of doing this has given satisfactory results; it consists in passing the solution through a chamber behind which are electromagnets, which hold the scale, enabling it to be removed. In America sulphate of soda or sulphuric acid have been used, the plate to be cleaned forming the negative electrode, an iron plate forming the positive one; the hydrogen which is thus set free reduces the oxides and decomposes any grease that may be present. Another method, in which there is less danger of injuring the surface of the metal, is to make the articles the positive pole of a battery, the negative of which is either carbon or wire gauze electroplated with silver and covered with platinum black, the bath being dilute sulphuric acid containing some nitric or chromium acid as a depolarizer. Attempts have also been made to remove the scale by pulling it off with powerful electromagnets, it having been previously loosened by immersion in the copper bath or by heating. —Cowper-Coles. Lond. "Engineering," Dec. 30.

ACCUMULATORS FOR AUTOMOBILES.

A brief description, with tables of data, of the Pulvis accumulator, is given by Reyval in "L'Eclairage Elec.," Dec. 24. This cell is characterized by the large active surface of the plates, adapting it to rapid discharges. The plates are made of sheet lead, having horizontal grooves close to each other on the surface, which are filled with an impalpable powder of lead. From a table of data, which seems very complete, the power output for a five-hour discharge is at the rate of 3.65 watts per kg of the cell, and the capacity is 18.25 watt hours per kg of the cell.—Reyval. "L'Eclai age Elec.," Dec. 24.

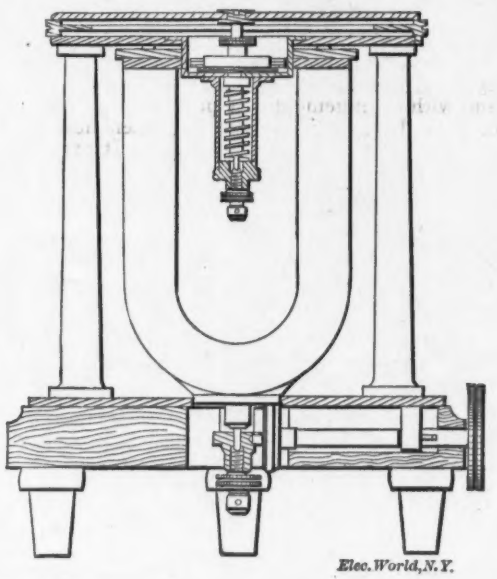
REFERENCES.

Production of Chlorine and Alkalies.—A description of the Le Sueur process in a paper read before the American Chemical Society in Boston, in August.—Parsons. "Jour. Am. Chem. Soc.," 20, p. 868; abstracted at considerable length in the "Zeit. f. Elektrochemie," Dec. 22.

Units, Measurements and Instruments.

HYSTERESIS METER.

A simple instrument for measuring the hysteresis of samples of iron is described in "L'Ind. Elec.," Dec. 25, from which the accompanying illustration is taken. The instrument is known as the Blondel-Carpentier hysteresis meter, and is similar in many respects to that of Ewing. The manipulation of it is very simple, and the samples required are small; it gives the value of the loss in ergs per cu. cm. of the sample; the induction is always uniform for the same instrument, and is about 10,000 C. G. S. units. The samples are in the form of rings cut out of the sheet metal, 38 mm outside diameter and 5c mm inside diameter, as many of them being taken together as will make a total thickness of 4 mm. These, after being annealed, are placed on a support, which is mounted on a pivot, as shown in the adjoining figure, though not very clearly. A spiral spring connected to the frame holding the samples provides the necessary directing force; the portion of the apparatus containing this is filled with thick valvoline to act as a damper; a pointer at the top indicates the amount of rotary deflection of the samples against the action of the spring. Around this, and with its poles on the same horizontal plane as the sample, is a permanent horseshoe magnet capable of being revolved around a vertical axis concentric with that of the sample; this magnet is revolved by means of the pulley shown at the bottom. If the magnet is rotated continuously every part of the sample ring will undergo a complete magnetic cycle, and there will be an amount of energy lost, which will be shown by the deflection of the sample in the direction of rotation. This deflection will be independent of the speed of rotation,



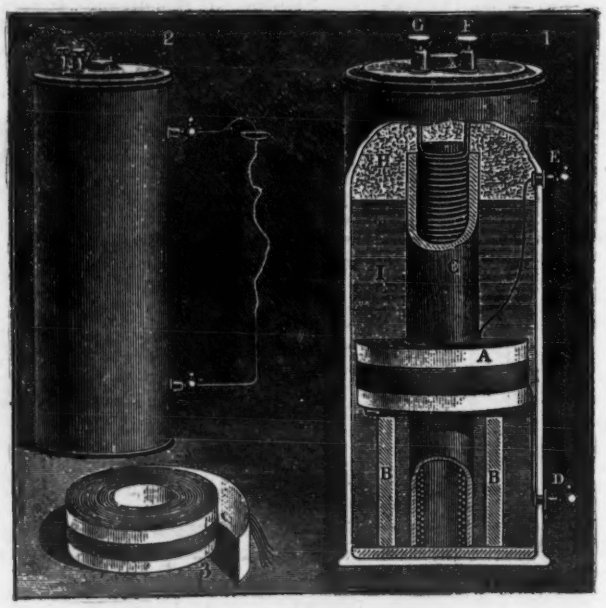
Elec. World, N. Y.

as is shown mathematically in the article. If the apparatus is constructed with an air gap of sufficient resistance that the reluctance of the sample is negligible, the induction of the sample will always be the same whatever the value of the energy in terms of which the hysteresis is measured. It is necessary to revolve the magnet first in one direction and then in the other, taking a mean of the two readings. To determine the coefficient of torsion of the spring, which enters into the formula, in ergs per radian, the method of oscillations may be used, the duration of an oscillation of the system being found, without iron, of course, and then again when it is loaded with a mass of known moment of inertia. When this value is introduced in the formula the hysteresis loss in ergs per

cu. cm. is easily calculated when the volume of a sample is known. The induction may be measured in the usual way by winding a small coil around one point of the ring and connecting it with a ballistic galvanometer. The instrument differs from that of Ewing in several respects; in the present apparatus the induction remains almost uniform in the iron, but the direction changes constantly, and it therefore measures what is called the rotating hysteresis, like that in continuous-current armatures; while in Ewing's apparatus the direction of the magnetic flux is almost constant, but the intensity varies alternately, and therefore what is called the alternating hysteresis is that which is measured. There are many who consider that the two values are different. The advantages in using a ring are that the induction is uniform in every point of the sample, the flux is constant, thus avoiding Foucault currents in the pole pieces and making the deflections proportional to the losses of energy, and it is easy by winding coils around the ring to verify the results by the ballistic method. The instrument can also be used by turning the magnet slowly, when it will be found that the sample will be deflected a certain amount but no more; the hysteresis loss can be determined from this deflection, but as the samples are not always homogeneous, this method is not as good as the one in which continuous rotation is used, which latter gives a sort of average for the whole sample; the method of slow rotation, however, is the only one that can be used when the iron has a greater thickness than 1 mm, as the Foucault currents then give rise to errors. A comparison of the two methods was made, and a table of results is given, together with a comparison with the values obtained by the ballistic method. This shows that the precision of this instrument is equal to that of other methods.—Armagnat. "L'Ind. Elec.," Dec. 25.

HIGH-VOLTAGE TRANSFORMERS.

What appears to be quite a simple and cheap form of induction coil for high voltages is described in a recent number of "La Nature," a translation of which is given in the "Sc. Am. Sup.," Jan. 7. It was devised by Wydts and Rochefort. Referring to the adjoining illustration, it will be seen to consist of a large cylinder of glass, containing a soft iron core, around which is wound a double layer of coarse, insulated copper wire, the terminals of which lead to the top of the apparatus; this primary coil is enclosed in the insulated tube *C*. The secondary coil *A* consists of a fine wire wound as shown; this fine coil is said to contain about 25 ounces of wire 0.006 inch in diameter. Whether the five small wires forming the secondary coil are connected in multiple or in series is not stated in the translation. The dimensions of the primary coil or the jar are not given. The outside jar of glass is filled with a pasty, carbulated insulating material. It is said to give a spark of 9 to 10 inches, with an expenditure of 4.5 amperes at 6 volts. It is said to have been improved recently so as to give a 20-inch spark without increasing the cost of construction. There is no internal, silent discharge. The quality of the spark is said to be that of one from



a static machine. A rotary mercury interrupter is used for replacing the hammer break. The transformer is said to have been used with success for producing Roentgen rays and for telegraphing without wires.—"Sc. Am. Sup.," Jan. 7. (See page 98, Electrical World, Jan. 15, 1898, for a description of this apparatus.)

Telegraphy, Telephony and Signals.

MAGNETIC SPACE TELEGRAPHY.

Dr. Lodge's interesting paper, the first part of which was abstracted in the "Digest" Jan. 7, is continued in the Lond. "Elec.," Dec. 23; "Elec. Rev." and "Elec. Eng.," Dec. 30. This portion is largely mathematical in character, and hardly admits of being abstracted. He discusses the question of space induction v. earth conduction, and the relative part which each plays in any given case; he considers it both from the experimental and from the mathematical point of view. He then describes some preliminary experiments made to find the value of the mutual induction coefficient was sufficient to give audible signals between couples of horizontal coils in the same place. In this he shows that it is simply mass of copper which is required to increase the power of a circuit for large distances, and that telegraphy over any distance by this method becomes, therefore, chiefly a matter of cost. The elementary theory of induction between a pair of circuits with condensers is given, and is applied to signaling a distance of 12,000 kilometres. It is shown how to calculate the amount of magnification of voltage caused by resonance. The best way of arranging the copper for distant signaling is discussed, as is also the possibility of using iron cores, which should be hot, so that the iron is as near its critical point as possible, both hysteresis and eddy currents being then at their minimum. The best size and shape of the coil for violent resonance is also discussed mathematically.—Lond. "Elec.," Dec. 23, and "Elec. Eng.," Dec. 30.

TELEGRAPHY BY MAGNETIC INDUCTION.

The recent paper by Dr. Lodge read before the Institution of Electrical Engineers in London was followed by one by S. Evershed, which is reprinted in full in the Lond. "Elec.," Dec. 30. Some years ago, in connection with the communication between light vessels and the shore, he made exhaustive experiments for investigating the principles of telegraphy by magnetic induction, and the object of the present paper is to give the condition then arrived at briefly. The paper is largely mathematical in character, and hardly admits of being abstracted. The two methods of constructing the inductive circuits are described and discussed, and an idea of the mechanical power, which can be delivered over several miles, is given. He shows that the telephone for such purposes is a very badly designed motor, with such an enormous combined resistance and inductive drop that the current is entirely independent of its back e. m. f.; a large component of the current in it is idle. But the telephone may be improved for signaling purposes when articulation is not required, the pitch being then lowered with advantage; such an improved device by him is described and shown.—Evershed. Lond. "Elec.," Dec. 30; reprinted in N. Y. "El'ty," Jan. 11.

Submarine Cables in Time of War.—An article in which the question of the right to use and cut cables in time of war is discussed. —Stockton. "Jour. of U. S. Institute;" reprinted in N. Y. "Elec. Rev.," Jan. 11.

Independent Telephony.—A description of the recently installed plant at Battle Creek, Mich. Also a short article on independent telephony in Illinois and Indiana.—N. Y. "Elec. Eng.," Jan. 5.

Line Disturbances.—A discussion of such disturbances, in the author's serial on American telephone practice.—Miller. "Amer. Elec.," Jan.

Telephone Party Lines.—A description of the Whittemore-Barrett-Craft system.—Webb. "Amer. Elec.," Jan.

Miscellaneous.

COST OF ELECTRIC COOKING.

Mr. C. O. Grimshaw, in a recent paper on the practical applications of electric power, gave some estimates of the cost of cooking at 8 cents per kw hour, which estimates are printed in the Lond. "Elec.," Dec. 23, as follows:

Description.	Capacity.	Cost per hour. Cents.		Cost for one operation from all cold. Cents.
Kettle	1½ pints	2.56		0.96
Griller	2 chops	4.48		1.06
Saucepan	2 quarts	3.2		1.6
Fish kettle	16 quarts	9.12		....
Domestic iron	scorching paper	1.6	cost to heat up	0.26

—Grimshaw. Lond. "Elec.," Dec. 23.

REFERENCES.

Electrical Industry 1898-1899.—A long series of articles under the general title of "the record and promise of the electrical industry." The introductory portion is a brief summary of the events of the past year, including a table showing approximately the value of the electrical apparatus made in the United States, amounting to nearly $70,000,000, and the value of that imported, amounting to only about a third of a million. The brief articles on the various subjects are as follows: "Electrical Railway Development of 1898," by Arnold; "Progress in Power Transmission," by Summers; "The Telephone in 1898," by Hibbard; "The Use of the Storage Battery," by Clark; "Isolated and Light and Power Stations," by Pierce; "Ten Months' Electrical Exports," by Tennville; "The Telegraph in 1898; the Progress of Central Stations," by Ferguson; "The Independent Telephone Movement," by Critchfield; "The Moto-Vehicle Industry," by Woods; and on "Electrical Construction and Inspection," by Ellicott.—"West. Elec.," Jan. 7.

Recent Developments in Electrical Engineering.—A brief summary of the first part of some recent remarks in which were reviewed briefly those developments which have a direct bearing on the other branches of engineering. The present portion refers to electric traction.—Hering. "Proceedings of the Engineers' Club, of Philadelphia," Jan.

Exports and Imports.—Some figures giving the export and im-

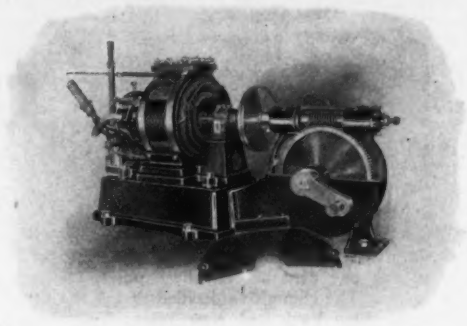
port trade of the United States and the exports of electrical material from New York.—N. Y. "Elec. Eng.," Jan. 5.

Electrical Outlook in Cuba.—A short article on the business outlook, with special reference to the electrical industry.—Thompson. N. Y. "Elec. Eng.," Jan. 5.

The Emerson Organ-Pumping Outfit.

The apparatus shown in the accompanying illustration has just been brought out by the Emerson Electric Manufacturing Company, 714-718 St. Charles Street, St. Louis, Mo., to meet the demand for a device of this character which has been steadily growing for the past few years. The outfit is arranged with an automatic clutch and connection to the organ-bellows, by which the pumping mechanism of a pipe organ is automatically regulated to supply the amount of air required. It is designed primarily for operation on alternating current, but it may be used equally well with any kind of current.

The motor shown in the illustration is of 1 horse-power and of the Emerson single-phase type. It is arranged with triple worm gear to directly transform the revolutions of the motor into the reciprocal crank motion required for an organ pump. The motor runs at 1800 r. p. m. In this system the motor is



ORGAN-PUMPING OUTFIT.

started and left running at a constant speed during the entire service or concert. The only disadvantage of this is the amount of current consumed while the pump is not in operation, and as this amounts to only 1.3 cents per hour on the 1-hp motor, with the rate of 10 cents per kw, the loss is a negligible factor. In fact, it is fully compensated for by the absence of extra current in starting several times, as would be the case if the motor were started each time the organ is used.

Several advantages are claimed for this outfit, the principal ones being the absence of regulating rheostats and sparking of contacts on stopping and starting. The outfit is also commendable for its simplicity and compactness of construction. It is designed and manufactured in a thoroughly first-class and workmanlike manner, to stand hard and continuous service with little or no attention, and may be so controlled as to pump fast or slow.

The Emerson Company lists six outfits for alternating current, three for 15,000 to 16,000 alternations per minute, and three for 7200 to 8000. It also makes three sizes for direct current, the motors in the latter being ½, 1 and 2 horsepower, and designed to operate on 110 and 220 volts. The 2-hp machine may also be operated on 500-volt circuits. As many churches are placed beyond the reach of direct current, but have alternating current available, this outfit no doubt will be welcome to these.

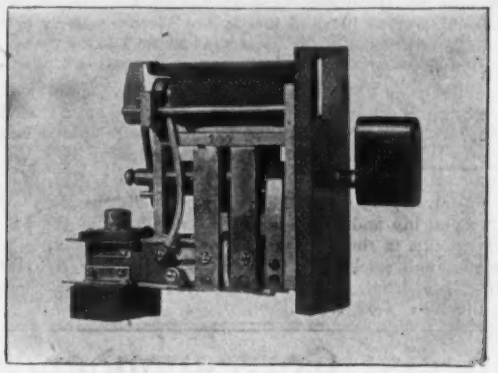
The Eureka Express Switchboard.

The Eureka metallic express switchboard, which is illustrated herewith, is said to be the most rapid and simplest central station telephone switching apparatus ever devised, and for rapidity of operation and economy of maintenance the manufacturer, the Eureka Electric Company, 157 South Canal Street, Chicago, Ill., claims it to be without an equal.

Each drop and jack is self-contained, and can be very readily and easily removed and replaced without disturbing the night-bell circuit or a single line connection. The clearing-out drop and operator's cam are also self-contained and removable.

The board is built in 100-line dust-proof frames, and so arranged that by removing the molding from one side of the cabinet additional boards can be placed side by side, thereby increasing the capacity of an exchange 100 numbers at a time. Each 100-line metallic board is equipped with a full operator's set. Over each set of plugs is a self-contained clearing-out drop and listening and ringing cam. The cam controls the ringing on either cord and the cutting in and out of the operator's set. With each set is included a hand generator wound to ring through a resistance of from 35,000 to 40,000 ohms, and having a large current output. This can be adapted for ringing either series bells on short lines or high-resistance bells on a long bridge line.

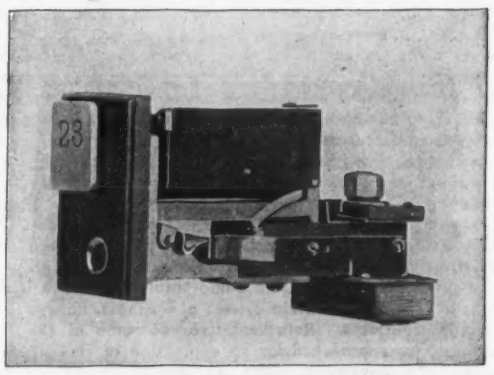
The Eureka long-distance amplifying solid-back transmitter is of improved construction. It has a metal solid back. The long-distance induction coil is silk-wound, and has fibre rubber heads, screw and washer terminals and soldered connections. The total width of the board is 19 inches, which is sufficient to permit the operator to sit comfortably and perform her work. It is stated that the company has one exchange using 300 numbers, all operated by one operator, and this it regards as proof of the claim made for rapidity of operation. Metallic boards are built either for common return, ground or complete metallic circuits, for use with either series or abridging telephones, or a combination of both. For large exchanges the transfer system is provided.



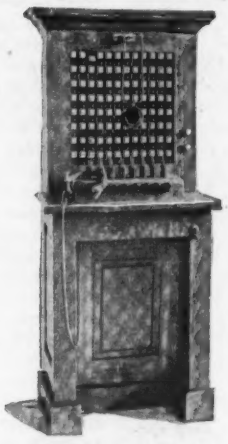
THE CAM.

In the operation of the board some novel features are noticed. Instead of dropping down upon the board the drops fall sidewise. This feature, the company claims, is the only correct solution of the self-restoring type board to keep the drops from interfering in any way with the operation of the same. After a call has been made and the drop has fallen the insertion of the plug into the jack places the operator's set in connection with the subscriber making the call. This avoids the necessity of having to move the listening cam to complete the operator's circuit. After ascertaining the number desired the operator takes the mate of the plug used and inserts it in the jack of the drop to which connection is desired. The operator then turns the cam to the left, thus ringing the subscriber desired without in any way ringing back into the first subscriber's ears. This same movement of the operator's cam to the left throws the operator's set out of circuit. The insertion of the plugs cuts out the main-line drops and cuts in a high-wound, bridged automatic restoring clearing-out drop. When disconnection is desired the ring-off from either side will drop the clearing-out drop of the circuit, and the operator then restores her cam to its normal position, which automatically restores the ring-off drop. Each ring-off is self-contained, in a hard-rubber case, with its own operator's cam. This is claimed to be a new and special feature, rendering the device easily accessible at any time.

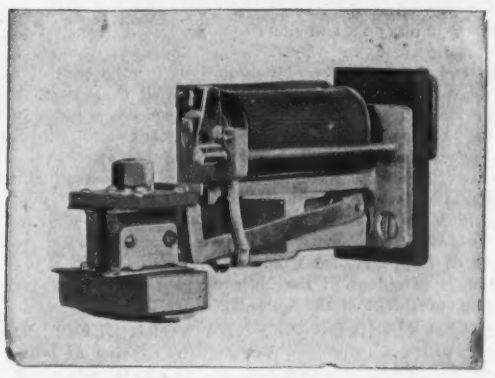
In construction the manufacturer claims that this board is first class, both electrically and mechanically. The highest grade of materials is used, and the mechanical accuracy and finish, as well as the durability of each component part, gives the apparatus long life under the most severe use. The same careful attention is given to every detail of construction. The plugs are strong and have no springs whatever. In the removal of a drop from a board for inspection or cleaning no tools are necessary; the simple loosening of one thumb-nut releases the jack and drop complete. The connections to the line points are made by a firm, positive contact and locking device. All windings are with silk insulated wire throughout, and hard rubber is provided for insulation in all cases where insulation is needed.



SIDE VIEW OF THE DROP.



EXPRESS SWITCHBOARD.



REAR VIEW OF THE DROP.

NEWS OF THE WEEK

Financial Intelligence.

INCREASE OF CAPITAL.—The Columbus Edison Electric Light Company, Columbus, Ohio, has increased its capital stock from $258,000 to $300,000. Its East Gay street plant is being improved.

THE ELECTRIC STORAGE BATTERY COMPANY'S EARNINGS.—A financial paper states that it learns that the net earnings of the Electric Storage Battery Company, of Philadelphia, for the last year will show between $475,000 and $500,000.

TRACTION EARNINGS.—The gross earnings of the Union Traction Company, Philadelphia, for December increased $42,000, and the net earnings (unofficial estimates) increased between $70,000 and $80,000, making a surplus over charges for the seven months of the fiscal year about $200,000.

MICHIGAN TELEPHONE COMPANY'S STOCK TO BE LISTED.—Information comes from Boston to the effect that application will shortly be made to the Boston Stock Exchange to list the stock of the Michigan Telephone Company, which is now controlled by the Erie Telephone and Telegraph Company. The Michigan Company has a capital stock of $2,500,000.

THE RAILWAY CONSOLIDATION IN BROOKLYN.—The official announcement on January 13 of the closing of the deal between the Brooklyn Rapid Transit Company and the Nassau Electric Railroad Company caused a jump of several points in the stock of the Brooklyn Company, and just before the close the quotation reached 95, or 5 points higher than it was at the close on Thursday. More details of the consolidation of these two companies are given among the New York Notes.

Special Correspondence.

NEW YORK NOTES.

WESTINGHOUSE RAILWAY APPARATUS FOR PARIS.—The Westinghouse Electric and Manufacturing Company has received advices from Paris to the effect that the contract for the electrical equipment of the Paris Metropolitan Railway has been awarded to the French Westinghouse Company. The apparatus will be built at the company's works at Havre.

THE NATIONAL CARBON COMPANY, the proposed organization of which was referred to in the last issue of THE ELECTRICAL WORLD, was incorporated at Trenton, N. J., on January 16, with an authorized capital stock of $10,000,000. The names of the incorporators are W. H. Lawrence, Myron T. Herrick, James Parmlee, Webb C. Hayes, all of Cleveland; J. C. Van Blarcom, of St. Louis; A. M. Young, Brooklyn, N. Y.; J. M. Humbird, and D. D. Dickey, of Pittsburg, and Hugh H. Hamill, of Trenton.

TO CARRY FREIGHT ON THE BROOKLYN SURFACE ROADS.—It is reported that details are being arranged for the formation of a company for the purpose of utilizing the Brooklyn trolley roads for carrying on a freight transportation business in that borough. The names of men well known in political life in New York city are mentioned as being interested in the scheme. The company, it is stated, will transport freight to and from warehouses, factories and docks, and the service will be carried on at night, so as not to interfere with the regular passenger traffic. The capital of the company will be $3,000,000. It is reported that as soon as the company has established itself in Brooklyn an effort will be made to extend the freight system to Manhattan and some of the other boroughs. The promoters of the new company believe that its greatest income will be derived from carting away ashes for the borough. The ashes are to be deposited on marshy land in the vicinity of Coney Island.

THE CONSOLIDATION OF THE BROOKLYN TROLLEY LINES has at last been effected. The official announcement of the closing of the deal was made on January 13, and the Brooklyn Rapid Transit Company acquired a controlling interest in the Nassau Railroad Company. This deal brings to an end the long-delayed negotiations for the control of the Nassau system, and places in the hands of Messrs. Roswell P. Flower, Anthony N. Brady and their friends nearly a monopoly of the surface railroads in Brooklyn. The only important line that remains outside of their control, and for which they are now negotiating, is the Brooklyn and Coney Island Railroad. It is reported that all of the Wilson and Johnson holdings of Nassau stock were delivered to the Flower syndicate on January 12, and on January 13 Messrs. Albert L. and Tom L. Johnson, R. T. Wilson and their friends resigned from the directorate of the Nassau Company, and were succeeded by directors representing the Brooklyn Rapid Transit Company's interests. Mr. Albert L. Johnson also resigned as president of the Nassau Company, and was succeeded by John T. Bourne, president of the Colonial Trust Company.

THE MEETING OF THE NEW YORK ELECTRICAL SOCIETY at the College of the City of New York on the evening of January 12 was a very successful one, a large number of members and friends being present. The subject of the lecture was the "Latest Progress in Storage Battery Installations," and was ably handled by Mr. Joseph Appleton, engineer of the construction department of the Electric Storage Battery Company. The audience listened with close attention to Mr. Appleton's record of the triumph of the storage battery after years of doubt and opposition. The lecture was illustrated by a large number of lantern slides, and the discussion which followed was participated in by Messrs. R. P. Bolton, Frank J. Sprague and C. O. Mailloux. The members then visited the storage-battery sub-station of the Metropolitan Street Railway Company at the foot of West Twenty-third Street. A description of this station is given on page 75 of this issue. The following named gentlemen were elected members of the society at the meeting; Arthur D. Dunn; Harvey E. Mole, J. S. White & Co., 29 Broadway; James A. Stiles, Newton Appliance Company, 120 Liberty Street; Henry I. Lurye, Walter S. Wilson, A. Haaber, New York Insulated Wire Company, 15 Cortlandt Street; Eugent F. Roeber, Herbert Jenkins, New York Insulated Wire Company, 15 Cortlandt Street; George V. Flynn, and Arthur Diamant, all of New York city.

PROPOSED TAX ON TELEPHONE POLES IN THE CITY.—A public hearing was given by the Council Committee on Streets and Highways on January 13 on an ordinance recently introduced, providing for taxing the telephone companies $10 per pole per year. Mr. S. H. Mildenberg, general manager, and Frank S. Gardner, secretary of the People's Telephone Corporation, argued against the measure. Mr. Mildenberg told the committee that if the ordinance were adopted it would mean that the company organized to reduce telephone rates would have to pay the city $800 a mile per year license for all its lines on which poles would be used. This would mean, he said, that the People's Telephone Corporation would not be able to carry out 7000 five-year contracts it had already made with telephone subscribers. It was to furnish unlimited telephone service to its subscribers in Manhattan for $100 a year. In Brooklyn the new company offered unlimited service for $75, while the New York and New Jersey Company charged $180. Mr. Gardner stated that in Brooklyn the New York and New Jersey company had made a contract years ago with the city, so that by paying half the expense of erecting the poles it was to share them with the Fire Department. Mr. Mildenberg said that in a majority of cases there was just one city wire on these poles, while the telephone company had from fifty to a hundred strung up. The company, he said, would not have to pay one cent tax on these poles, for they would be regarded as city property. The committee decided to ask the corporation counsel if the contract of the New York and New Jersey Telephone Company with Brooklyn could not be annulled.

TAMPERING WITH METERS.—It is not often that the patrons of electric light companies have it in their power to effect a reduction in their light bills, but a few Newark consumers of electric current have had a recent experience which taught them an important lesson in electricity. Their experience also illustrates the cupidity of human mortals, and how futile it is to try to get something for nothing. A genius in Newark, a Samuel Johnson—an electrician, of course—went among the patrons of the electric light company offering to attach to their electric meters an invention of his, which he called an "electric light regulator," and which he claimed would cut down their electric light bills at least one-half. "He didn't want a cent until I was satisfied," said one customer. "It looked like a good thing, and I let him go ahead. I don't know a thing about electricity, but I do know that my bill for that month was less than half what it was the month before, and, as I wasn't kicking about my lighting bills, I put in a lot more lamps; sort o' blew myself on lights, as it were. I told some of my friends, and they got Johnson to put in his device, and everything worked all right until one day an electric light inspector looked in and told me that my meter was 'plugged in.'" It seems that Johnson's "invention" consisted of running a shunt around the meter. No wonder the electric light bills fell off. The "invention" was very simple; in fact, so simple that the People's Electric Light & Power Company saw through it at once, and caused Mr. Johnson to be locked up. He will be given an opportunity to determine to his own satisfaction whether, after all, his invention paid. President Philip N. Jackson, of the People's Electric Light & Power Company, proposes to make an example of Johnson.

REPORTED COMBINATION OF GAS AND ELECTRIC LIGHT FIXTURE INTERESTS.—It is reported that there is a movement in progress for the consolidation of the leading manufacturers of gas and electric light fixtures. Most of the large houses in the trade are in New York and Philadelphia, but there are three in Chicago, one in Cleveland and one in San Francisco. It is stated that if the combination is effected the interests of about eighteen manufacturing concerns will be united, representing about 90 per cent. of the total yearly output in the trade, which is vauled at about $6,000,000. The substantial assets of the companies concerned are estimated at over $5,000,000. Back in the eighties an agreement was made among the manufacturers to prevent disastrous competition and the cutting of rates. It was mainly an agreement as to prices, and was merely a verbal compact not enforced by any contracts or penalties. This agreement was lived up to fairly well for several years, but it finally yielded to the necessity of every manufacturer acting for himself. Sharp competition has prevailed in the past four or five years as a result of the breaking up of the compact, and it is for the purpose of placing the business on a better basis that the idea of the consolidation is being carried out at the present time. Inquiry by THE ELECTRICAL WORLD as to the truth of the report of the proposed consolidation revealed the fact that in certain directions overtures have been made having in view a consolidation of these interests. The idea of the proposed combination is the elimination of the cut-throat competition which is a feature of the present-day methods of securing certain classes of business, notably large government and municipal contracts. Representatives of some of the large concerns in this city, who were approached for an expression of an opinion as to the probable success of the movement, stated that similar efforts had been made before, and that the outcome of the present negotiations is extremely problematical.

COMPRESSED AIR COMPANIES ORGANIZED.—As electrical engineers are more or less interested in the applications of compressed air as a motive power reference to recent developments in this direction may prove interesting at this time. In the last issue of THE ELECTRICAL WORLD it was noted that it was proposed to introduce in New York several "auto-trucks," and it was also pointed out that a reorganization of the compressed-air interests was about to take place. On January 14 the International Air Power Com-

pany was incorporated at Trenton, N. J., with a capital stock of $7,000,000, the incorporators being Robert I. McKinstry, Joseph H. Hoadley, William H. Knight and Henry E. Knight, of New York, and Edwin F. Glenn, of Philadelphia. The common stock is to be issued for the purchase of property. On the same day the New York Auto-Truck Company was incorporated, with a capital stock of $1,000,000, the incorporators being Richard Croker, Nathan Straus, Lewis Dickson, Arthur P. Gorman, Joseph H. Hoadley and Robert I. McKinstry. The latter-named concern is a companion to the International Air Power Company, and both are, by their charters, authorized to manufacture, buy and sell compressed air and electric machinery and apparatus, locomotives, engines, trucks and cars, and to manufacture machinery for supplying electric power, compressed air and motive power. The first-named company will manufacture the machinery and apparatus for the Auto-Truck Company under patents controlled by Joseph Leiter, of Chicago. Mr. Leiter is quoted as saying that the International Company owns the rights and patents all over the world which the American Air Power Company owned, with the exception of the street car rights in North and South America, which the latter concern still controls. The International Company will be a manufacturing company. Its factories will be at Worcester, Mass., and Providence, R. I., and its products will be all kinds of vehicles, the motive power of which will be compressed air. Mr. Leiter states that the Metropolitan Street Railway Company, of New York, is largely interested in both the American Air Power Company and the International Company. It is the American Air Power Company which is now equipping the cross-town lines of the Metropolitan Street Railway Company with compressed-air motors. He stated that he had nothing to do with the Auto-Truck Company, of which Mr. Richard Croker is one of the incorporators. He, however, said that this company would control the trucking business of this city. His company, he stated, had demonstrated by experiments that compressed air for motive power is cheaper than horse-power, although he was not at liberty to give the comparative figures. Mr. W. H. Knight, who is one of the incorporators of the International Air Power Company, was formerly an engineer of the General Electric Company. It is reported that he has been appointed chief engineer of both the International and Auto-Truck companies. He is also chief engineer of the American Air Power Company, of New York, which is owned by the Whitney syndicate.

NEW ENGLAND NOTE.

THE BELL TELEPHONE COMPANY MAY SEEK A NEW HOME.—It is reported that the Bell Telephone Company, in order to escape the restrictions imposed upon corporations by the laws of Massachusetts, may move its headquarters to New York or some other State where the laws are not so rigorous. New Jersey is mentioned as the possible future legal home of the company. The Bell Company, it is stated, has decided to expand on both the share capital and a bond basis, and is now giving attention to the corporate laws of other States. According to the laws of Massachusetts, corporations are forbidden to contract any indebtedness beyond 50 per cent. of the par value of the stock. With a capital of about $25,000,000, as at present, or even $30,000,000, to meet proposed extensions during the present year, the company cannot legally issue more than $12,500,000 or $15,000,000 in bonds, although the market price of the stock is nearly $75,000,000. It is stated that an influential minority in the Bell management has always favored the idea of moving out of the State. Local officials, however, are non-committal on the subject.

PHILADELPHIA NOTES.

"BIDDLE'S BULLETIN," which is published by James G. Biddle, of Philadelphia, describes and illustrates in the December issue the Jagabi portable testing set which was illustrated in THE ELECTRICAL WORLD of December 24, 1898.

THE FRANKLIN ELECTRICAL SUPPLY COMPANY, of Philadelphia, has issued an attractive perpetual calendar. Mr. H. P. Feister, proprietor of this company, will be glad to send one to responsible persons upon application.

THE MAIN BELTING COMPANY, of Philadelphia, has just issued a very neat little memorandum book for 1899, with a celluloid calendar on the back. This book will be sent free upon application to superintendents of electric light stations.

FIRE VISITS MR. WIRT'S FACTORY.—Mr. Charles Wirt, 1026-1028 Filbert Street, Philadelphia, had an unwelcome visitor early in the morning of January 10 in the shape of a slight fire. Fortunately, however, the fire caused slight damage, and Mr. Wirt reports that no interruption to the filling of orders for rheostats, brushes, etc., will be occasioned by it.

DISSOLUTION OF CO-PARTNERSHIP.—The co-partnership hitherto existing between Arthur Falkenau, Edward R. Keller and Clayton W. Pike, under the title of the Falkenau Engineering Company, Limited, expired on December 31, and will not be renewed. Mr. Falkenau has withdrawn, and the business will be continued and conducted as heretofore by Messrs. Keller and Pike without any change. The title of the new firm will be Keller, Pike & Co., and their address will be the same as that of the concern which they succeed, namely, Reading Terminal. Mr. Falkenau retires from the business on account of the many demands upon his time and his consequent inability for some time past to devote himself to the interests of the company. Messrs. Keller, Pike & Co. state that they are now in a better position than ever to execute electrical contracts.

BUFFALO AND NIAGARA FALLS NOTES.

THE NEW YORK ELECTRICAL MACHINE COMPANY, of Buffalo, has been incorporated to manufacture electrical machinery. The directors are James Tate and Fred. Wardell, of Buffalo, and Thomas E. King, of Arbel, Pa.

THE NIAGARA FALLS POWER COMPANY has placed with the Westinghouse Electric and Manufacturing Company orders for two 5000-hp generators of its standard type, to be delivered about October next. This will increase the station capacity to 50,000 horse power.

THE WILSON TELEPHONE COMPANY has been incorporated to build and operate a telephone system between Wilson, Lockport, Youngstown, Lewiston and other towns and villages in western New York. The directors are George Wardsworth, A. N. Dwight, J. P. Tenbrook, W. N. Harriss and George Mont, of Wilson; B. A. Stone, of Pike, and Fred. Haner, of Tonawanda. Capital stock, $2000.

ELECTRIC RAILWAY DECISION.—The decision of the Court of Appeals in the case of the Nassau Street Railroad Company, of Brooklyn, allowing a street railway to operate over the tracks of another street railway without obtaining consent of abutting property owners will affect the Buffalo and Niagara Falls Electric Railway and the Buffalo, Bellevue and Lancaster Electric Railway in an important degree. The cars of these roads are now operated on tracks of the Buffalo Railway Company within the city limits by the Buffalo Railway Company's employees, and in all respects as local cars, so that they often become so crowded with local passengers as to exclude through passengers. By the new ruling they will be able to refuse local passengers when it seems desirable.

PITTSBURG NOTE.

THE SONS OF THE TAMMANY CHIEF STUDYING ELECTRICITY.—Richard Croker, Jr., and Frank Croker, sons of Mr. Richard Croker, of New York City, evidently do not intend to adopt their father's means of earning a livelihood. Richard is an employee of the Westinghouse Electric & Manufacturing Company at its East Pittsburg shops, and is working at the bench in an endeavor to acquire a practical knowledge of electrical manufacturing and engineering. He states, however, that he does not intend to follow electrical engineering as a profession, but believes a knowledge of its practical side will help him in the consideration and proper conduct of the commercial end of the business. His brother Frank, it is stated, will pursue the same course of instruction, with the same end in view.

INDIANA NOTES.

JUDGES MUST PAY FARE.—A bill has been introduced in the Indiana Legislature making it unlawful for judges of Indiana courts to accept passes or free transportation over railway or street railway roads.

AN INDEPENDENT TELEPHONE SYSTEM FOR NOBLESVILLE.—The Common Council of Noblesville has granted the New Telephone Company a franchise to operate a telephone system in that city. This will bring the company in competition with the Bell Company.

A RECEIVER FOR A STREET RAILWAY.—W. H. Stevens, of Detroit, has applied for a receiver for the Kokomo Electric Street Railway Company, the object being to clear away certain incumbrances and facilitate the sale of $70,000 in bonds, so as to improve the plant. Mr. Stevens owns all but $1500 of the original $75,000 in stock.

THE LONG-DISTANCE TELEPHONE COMPANY has secured a right of way through Shelby County, for the construction of a line from Indianapolis to Shelbyville. It will connect the New Exchange in Indianapolis and the Mutual Exchange in Shelbyville, which has a large number of farmer patrons, and numerous towns in southern Indiana.

AS TO CONTRACTS BETWEEN EMPLOYERS AND EMPLOYEES.—Senator Winfield introduced a bill to declare null and void all contracts entered into between employer and employee as to liability. The object of the bill is to do away with the plan of corporations to force their employees to go into relief associations, and by reason of the benefits derived sign a contract to relieve the corporations from liability for injury or death.

STREET RAILWAY DEAL IN INDIANAPOLIS.—There is evidences of a street railway deal now in progress in Indianapolis. It is generally believed that the Citizens' Company, whose charter expires next year, is inclined to purchase the City Company's franchise and operate under it rather than face confiscation of its property. The City Company's franchise requires the payment of 10 to 14½ per cent. of the gross receipts to the city.

TELEGRAPH LINES ALONG RAILWAYS.—The sheriff of Madison County has been instructed to select a jury of twelve men to follow the line of the Big Four railway from Indianapolis to Union City, and from Anderson to Marion, to assess damages which may accrue to the railway by a telegraph line belonging to the Postal Company along the railway. The Western Union Company claims full right of way, and the Big Four is understood to favor it. Judge McClure, who directed the selection of the jury, says that an old act of Congress empowers him to decide the matter that way.

BILL TO REGULATE STREET RAILWAY FARES.—Senator Hugg introduced a bill in the Senate for an act regulating and fixing the fares of street railroad companies incorporated under and pursuant to an act providing for the incorporation of street railroad companies. The bill provides for transfer tickets, for the paving between tracks and for 18 inches on the outside, for the purchase of eight tickets for 25 cents, good for passage between the hours of 5:30 and 7:30 A. M. and 5 and 7 P. M. on any day except Sunday, the Fourth of July and Christmas, and provides for a penalty for charging a higher fare. The bill provides for heating the cars and regulates the manner and time of running cars. The bill declares an emergency.

ELECTRIC TRANSPORTATION AND EXPRESS SERVICE.—Indiana seems to be following close after New England in the matter of establishing and building electric lines. They run up and down through the gas belt and through northern Indiana, and projected lines run out in every direction from Indianapolis, so by the close of the year one may travel all over the State on an electric car. Indianians are never satisfied with half-do anything, and the intention of carrying freight and express packages worry the steam railroads quite extensively. The operation of the electric lines has already reduced the passenger business of steam railways where brought in direct competition at least 70 per cent. The latter threaten to make a cut in the rate, but the electric lines say they will meet it. Wherever the trolley passenger and package express is being operated, loud complaint comes from the rural storekeepers, who say their customers are going to the cities to trade, and have their packages delivered free by contract entered into by the city merchants and

trolley company. Efforts are being made to induce county commissioners to grant no more rights of way, but the chances are that trolley service will be greatly increased all over Indiana. The result, of course, will be a loss of trade to the local storekeepers, just as the great department stores have nearly ruined the business of local tradesmen or shopkeepers. In Indiana, as elsewhere, however, the great convenience to the public from having these lines of transportation running through the country is so pronounced that probably no power can impede their progress.

Chicago Notes.

A NEW TRACTION ENTERPRISE.—At the meeting of the North Chicago Street Railway Company on January 10 Mr. Yerkes recommended the organization of a new traction company with a capital of from $10,000,000 to $15,000,000 to absorb nine suburban feeder lines of the North and West Sides. These nine roads have a capitalization and bonded debt of $21,961,000, and they are all operated in the interest of the Yerkes roads. They have a mileage of about 160 miles.

THE ILLINOIS TELEPHONE & TELEGRAPH COMPANY has asked the City Council for the right to maintain and operate a telephone system in this city. The franchise asked for is practically on the same lines as that under which the Chicago Telephone Company is operating. The new company agrees to furnish instruments for business houses for $85 a year and to residences for $50. The ordinance has been recommended for passage. The present rates for telephones charged by the Chicago Telephone Company are $150 per annum for business and $100 for residences.

THE ANNUAL MEETING of the West Chicago Street Railway Company was held on the afternoon of January 10. The report shows that the total receipts from passengers and other sources were $4,031,903, which is an increase of $131,983 over the previous year. The total operating expenses were $2,017,946, representing an increase of $88,282. The total profit from operation was $2,013,957, an increase of $43,703. After deducting fixed charges, taxes, interest, rentals, etc., a profit of $815,956 is shown. From this were paid dividends amounting to $791,340, leaving a balance of $24,616. The company carried on all its lines, including full fares and transfers, 111,916,319 passengers, showing that the receipts per passenger carried were 3.55 cents.

A NEW RAILWAY FRANCHISE PROPOSITION.—Mayor Harrison has recently received from a syndicate a proposition to take all the existing street railroad franchises in the city, and charge a 3-cent fare during certain parts of the day. The proposition is signed by Mr. H. W. Duncanson and Samuel A. French, who, it is stated, are merely the figureheads of a syndicate which is ready to advance $100,000 in cash or a $1,000,000 bond as a guarantee of good faith. A provision is made for the purchase of all the plants by the city at an appraised value at the expiration of the franchises, which are to be extended twenty-five years. To accomplish this it will be necessary to amend the law, and the Council is asked to memorialize the Legislature to that end.

Wisconsin Notes.

CAR FENDERS IN MILWAUKEE.—The Milwaukee Electric Railway and Light Company is equipping all of its cars with car fenders.

RAIL-WELDING PATENT CASE SETTLED.—A settlement has been made out of court of the suits in which the Milwaukee Rail Joint and Welding Company, W. J. Austin and E. E. Warner were principals. The suits involved interests in a patent. Reference to this suit was made in The Electrical World of December 31, 1898.

St. Louis Notes.

FRANCHISE GRANTED.—The City Council of Belleville has granted a franchise to the Belleville City Electric Railway Company to construct a road on certain streets in Belleville.

MISSOURI PACIFIC TELEGRAPHERS.—The general committee of the Missouri Pacific Telegraphers was in session here a few days ago. Representatives from each of the lines comprising the Missouri Pacific system were present and officers were elected.

THE CENTRAL TELEPHONE AND ELECTRIC COMPANY has been incorporated with a capital stock of $10,000. The stockholders are James S. Cummings, Charles A. Powers and Paul Reiss. The company will manufacture telephones and appliances.

BANQUET OF ELECTRIC LIGHT MEN.—The Missouri Edison Club, composed of the employees of the Missouri Edison Electric Light and Power Company, gave a dinner last week at the Mercantile Club to the incorporators of the old Missouri Electric Light and Power Company and the present Missouri Edison Electric Light and Power Company. Mr. Herbert A. Wagner, president of the club, presided, and delivered the opening address on "Our Guests and the Occasion." The other subjects and speakers were: "History of Ten Years' Lighting in St. Louis," Sherman B. Pike; "Use and Sale of Electricity in St. Louis," F. B. Beardslee; "Station Operator," E. A. Cardes; "Electrical Equipment," D. W. Roper; "Ten Years of Pole Line Construction," Geo. A. Warrance; "The Underground System," E. C. Freeze; "Our Draughting Department," F. E. Bausch; "Experiences and Reminiscences of Ten Years' Station Operation," P. J. Parker; "Electric Meters and Testing," T. S. Clack; "Direct Current Series Arc Lighting," H. D. Cunningham.

Pacific Coast Notes.

THE WALLA WALLA (WASH.) ELECTRIC COMPANY recently made the concession of offering to supply the city with arc lights for $8.33 per month.

ENLARGING TELEGRAPH FACILITIES.—An additional wire was strung recently by the Western Union Telegraph Company from Seattle to Port Angeles, Wash. The new line to British Columbia occupies the same right of way.

A MUNICIPAL LIGHTING PLANT FAVORED.—Mayor Phelan, of San Francisco, in his recent message to the new Board of Supervision, declared himself as strongly in favor of the installation and operation of municipal light and water systems.

ENGLISHMEN INSPECTING AMERICAN TELEPHONE SYSTEMS.—Messrs. Gavey and Cooper, prominent officials of the English postal service, who are making an investigation of the telephone systems of the United States, recently inspected the Central Office and branch exchanges of the Pacific and Sunset Telephone companies in San Francisco. Mr. Cooper is the chief electrician of the Postal Telegraph of England.

A 2-PHASE TRANSMISSION PLANT CONTRACTED FOR.—The Utica Mine Company has awarded to the Westinghouse Electric and Manufacturing Company a contract for a 2-phase water-power electric transmission plant, which will be used to operate its mining works near Angel's Camp, Cal., and to supply current for commercial purposes in the surrounding country. The generating machinery will consist of three 1,000-hp units. Water will be taken from the Stanislaus River, below Copperopolis.

SAN FRANCISCO'S LIGHTING CONTRACT DECLARED VOID.—Judge Seawell recently decided that the contract entered into by the San Francisco Gas and Electric Company and the late Board of Supervisors is void. This decision, in the case of the Mutual Electric Light Company vs. the Board of Supervisors, sustained Mayor Phelan's veto of the gas contract. His objections were: That the specifications excluded competition, and that the contract was let for two years, when the law authorizes a contract for one year only. The supervisors can now be compelled to invite new proposals for lighting. Under the decision, the lighting company will be allowed to collect for light already furnished since the expiration of the old contract, without respect to the present contract.

Canadian Notes.

THE TORONTO ELECTRIC STREET RAILWAY gross receipts for 1898 were $108,924, as compared with $99,336 for the year previous.

MUNICIPAL LIGHT PLANT FOR HULL.—A by-law has been passed by the Council for the city of Hull, Que., providing for a loan to purchase dynamos and give the city its own plant for electric lighting, operated by its own water power, which cost the corporation $25,000. The lighting committee is now asking for tenders for poles, wires, lamps and dynamos.

THE ANNUAL MEETING of the shareholders of the London (Ont.) Electric Street Railway was held a few days ago. Notwithstanding the loss entailed by the recent and prolonged strike of the railway's employees, the gross earnings showed an increase of over $12,000 during the past year. The number of passengers carried in the year was nearly 3,000,000. The gross earnings per capita of the population was $2.95.

A MODERN RAILWAY CONSTRUCTION DEPARTMENT.—The directors of the Montreal Electric Railway have just decided on a new departure which will have a most important effect upon the future of the company and its construction department. After much consideration the board has decided to concentrate the company's entire business at the Hochelaga workshops. The company intends in the spring to build a large brass foundry for the manufacture of its brasses and a large iron foundry for the iron work required in connection with its cars, an important part of this being the wheels. The new buildings required for this work of centralization and expansion will involve an expenditure of upward of $500,000.

French Notes.

ELECTRIC CABS IN PARIS.—The Paris Carriage Company will put twenty electric cabs in the streets of Paris during the coming month. The company expects to have 1000 carriages in operation at the time of the exposition. The stables on the Rue Cardinet have been converted into a charging station already.

ELECTRIC TRACTION AT ST. GERMAIN-EN-LAYE (SEINE-ET-OISE.)—The mayor of St. Germain has just received from M. Nave, engineer, the first plans for an electric road to start from Nanterre and to end at Lafitte, This line will be about 10 miles long, and will pass through Rueil, Chaton, Le Vesinet, Le Pecq, St. Germain and Mesnil-le-Roi, connecting at Maisons-Lafitte with the Neuilly line, which is now building. The Neuilly-Maison Lafitte Company is seeking to obtain a concession for an extension of its line from Maisons-Lafitte to St. Germain via Carrières, with a view to obtaining a terminus at St. Germain, where it can connect with lines running to Poissy and Paris.

ELECTRICITY AT PORRENTRUY-DELEMONT, FRANCO-SWISS FRONTIER.—A stream called the Doubs has been dammed at a point about 4000 feet above the Soubey Bridge, and the water is led through a tunnel 12,000 feet long across the "Clos du Doubs" on Swiss territory, skirting the French boundary. The fall thus obtained at the end of the tunnel, where the water is returned to the Doubs River, is 180 feet. The dam is built diagonally across the river, and has a useful length of 198 feet. The gauging of the river in 1894 indicated a mean flow, in low-water times, of 212 to 247 cubic feet of water. The capacity of the plant was reckoned on a basis of 212 cubic feet, and the flume is built to take care of 250 to 280 cubic feet per minute. The surveys were laid out by Professor Smidt, of Bâle, and the tunnel for the most part is driven through hard lime-stone, and presented no unusual constructional difficulties. The power house will be on the left bank of the Doubs, and will contain four turbines and generators, rated at 1000 horse-power each, one of them being a reserve unit. Two circuits will be run from the Ocourt station, one to Porrentruy, and the other to Délémont. The turbines will furnish 3300 horse-power at 212 cubic feet of water per second, 2750 horse-power at 176 cubic feet, and 3850 horse-power at 282 cubic feet, etc., adding 560 horse-power for every addition of 35.5 cubic feet of water flow. The plans, reports and designs were submitted to experts and received their approval. The company undertakes to do all necessary construction work, including secondary as well as primary wiring, right up to the lighting fixtures, at its expense, and it offers to furnish power to towns at the following maximum rates:

Lighting. Lamps.	Category and Price Per Year. I.	II.	III.
5 candle-power	$2.00	1.00	1.20
10 "	3.50	2.60	2.00
16 "	4.80	4.00	3.20
25 "	7.00	5.60	4.80

The first category includes: Eating-house and hotel kitchens and corridors, and public lighting. The second includes: Shops, living-rooms, kitchens of private houses, offices, factories, work-shops, corridors and halls and lobbies of hotels. The third category includes sleeping chambers, cellars, stables, water-closets (with switches), meeting halls, school-rooms, public offices. Those who wish to use a meter will be charged 12 cents per kw hour, and the cost of the meter to be borne by them.

Power for Motors.

Up to ¼ hp	$40	per hp per year
¼ to 1 hp	34	" " " "
1 to 3 hp	20	" " " "
3 to 10 hp	28	" " " "

And in addition there will be a charge of 4-5 cents per hour and per horse-power of operation.

General News.

THE TELEGRAPH AND TELEPHONE.

CONVOY, OHIO.—The Interstate Telephone Company has completed its line to Howe and Auburn.

MUSCATINE, IA.—The Henry County Telephone Company, with a capital stock of $1000, has filed articles of incorporation. New London is the headquarters.

BUCKSPORT, ME.—The Bucksport & East Orland (Me.) Telephone Company has closed a contract with the New England Telephone & Telegraph Company whereby the former system will be connected with the latter.

BOSTON, MASS.—During the year 1898 the Erie Telephone and Telegraph Company made a net gain of 10,742 subscribers, representing an increase over the previous year of 26½ per cent. The total number of subscribers connected on January 1, 1899, was 51,261, distributed as follows: Cleveland, Ohio, 6874; Northwestern system, 9129; Southwestern system, 16,041; Michigan, 19,217.

WASHINGTON, D. C.—A bill was introduced into the Senate on January 14 by Senator Butler, of North Carolina, authorizing the construction and operation by the United States of a telegraphic cable from San Francisco to Honolulu, thence to Manila by way of Ualan and Guam, thence to Hong Kong. The rates per word are not to exceed 35 cents from San Francisco and Honolulu, $1 between San Francisco and Manila, and $1.20 to Hong Kong. Press rates are to be one-quarter of the above figures. The bill appropriates $8,000,000.

CLOVERPORT, KY.—The Ohio County Telephone Company and the Fordsville Telephone Company have consolidated, and have decided to build a line from Fordsville to Owensboro direct, by way of Whitesville, Deanefield and Philpot, connecting with the Harrison exchange at Owensboro. It will be a metallic circuit. The company has strung its wire from Fordsville to Sulphur Springs, and is pushing on to Hartford and Beaver Dam, and by January 15 will have its line up to the two latter named places and the instruments put in.

CHICAGO, ILL.—It is stated that there is a project on foot to connect the various cities within 500 miles of Chicago with an independent combination telegraph and telephone system. The work of arranging for the organization of this combination, it is said, has been under way for the last eight months. The independent corporation which, it is thought, will be ready to begin business within the next few weeks will have a capital of $1,000,000 to start with. It is intended to link the cities of St. Louis, Omaha, Sioux City, St. Joseph, Kansas City, Indianapolis, Fort Wayne and Detroit with Chicago. It is stated that several large packers are interested in the scheme.

ANNAPOLIS, MD.—The people of the lower part of Anne Arundel County are now beginning to experience the benefits of having communication with the outside world. The company which was organized to construct and operate a telephone line from Baltimore to Drum Point has completed the line from Annapolis to near Friendship, on the northern border of Calvert County. In all the country from Annapolis to Drum Point, a distance of about 60 miles, there is not a railroad, a telegraph, a stage coach nor a turnpike road. A part of the country is fertile, productive and well populated. It is a narrow peninsula, and no place is more than 5 or 6 miles from navigable water. So the steamboats furnish ample transportation facilities. But they do not supply quick communication, and this want the telephone will supply.

ELECTRIC LIGHT AND POWER.

POTTSTOWN, PA.—The Pottstown Council has made a contract for electric lighting for five years at the rate of $75 per year for arc lights and $29 per year for incandescent lights.

MOLINE, ILL.—The arsenal power house, located on the bulkhead, between the Government and Sylvan islands, was entirely destroyed by fire on January 3. The loss on the frame house was trifling, but on the machinery it may run up to several thousands. There was no insurance, as the Government never insures its property.

NEW YORK, N. Y.—It is stated that the General Electric Company has closed a contract with the St. Anthony's Falls Water Power Company, of Minneapolis, Minn., for the completion of the equipment in the latter company's power house. The contract amounts to $150,000, and it will complete improvements aggregating $600,000.

WOLFEBORO, N. H.—The Wolfeboro Fire Precinct has recently installed a new 125-hp Harrisburg Ideal engine to run its electric light plant. The plant has been running a little over a year, but the increased demand for current has necessitated this change. The plant now carries 168 30-cp series street lights, and about 770 16-cp lights on the commercial circuit.

RED BANK, N. J.—The Monmouth & Middlesex Electric Heat, Light & Power Company is a new corporation which will build electric light plants at South Amboy, Mattawan and Keyport. John Karr, who recently obtained a franchise to light Keyport's streets with electric lights, is the principal stockholder in the new company. Mr. Karr has bought the Keyport and Mattawan horse-car line, and it will be changed to a trolley line in the spring.

PHILADELPHIA, PA.—A director of the Pennsylvania Manufacturing Company, in referring to the Electric Lighting Company of America, which was recently organized at Trenton, N. J., is reported to have stated that the company is the outcome of differences of opinion in the Pennsylvania Manufacturing Company's board of directors regarding the policy of expansion. The company will take over the properties outside of Philadelphia recently acquired by the Pennsylvania Manufacturing Company, paying the latter cash for expenditures made, and carrying out the policy of the United Gas Improvement Company in acquiring gas properties.

EAST ORANGE, N. J.—The East Orange Township Committee took a practical step against the People's Light and Power Company, of Newark, recently in cutting the electric wires leading from Newark to the township, which were put up without permission of the township. The company secured an injunction from the Court of Chancery forbidding the Township Committee from interfering with the electric light and power wires which were strung on the poles of the New York and New Jersey Telephone Company. Vice-Chancellor Pitney ruled that these wires were properly on the poles by permission of the telephone company, and that the poles had been lawfully set. The wires that were cut, while not technically the same as those covered by the injunction, were strung on the poles of the telephone company. They carried the current from the power house in Newark. There was no attempt made by force to prevent the wires being cut. This action will no doubt be the beginning of another fight in the Chancery Court.

THE ELECTRIC RAILWAY.

HOLYOKE, MASS.—The Holyoke Street Railway Company has declared an annual dividend of 4 per cent.

SOUTH BETHLEHEM, PA.—The South Bethlehem & Hellertown Street Railway Company has just declared its usual quarterly dividend of 1¼ per cent.

OTTAWA, ONT.—At the election in this city on January 2 among other matters voted upon was the proposition to run street cars in this city on Sundays. This was carried by a plurality of 2000.

CLEVELAND, OHIO.—The Cleveland, Berea, Elyria and Oberlin Electric Railroad Company proposes to build a line from Rockport through Linndale, and connect with the main line at Lorain street. A twelve-mile extension from Berea to Medina is also contemplated.

CINCINNATI, OHIO.—At the meeting of the directors of the Cincinnati, Newport and Covington Street Railway Company a dividend of one-half of 1 per cent. was declared on the stock. It is the intention of the directors to declare a similar dividend every six months from now on.

BETHLEHEM, PA.—It is reported that the projectors of the new trolley road from Allentown to Slatington are meeting with encouraging success in securing franchises and that the construction of the line will be begun next spring. It is proposed to make it as near an air line as possible, and for that reason no spurs will be built to many of the villages near the proposed route.

NEW YORK, N. Y.—The Brooklyn Heights Railroad Company is advertising for men to act as conductors and motormen. Applicants must weigh from 160 to 200 pounds, and be not less than 5 feet 8 inches in height. It is also stipulated that they be of average intelligence and have good references. At this season many railroad employees are ill, and the road takes this means to secure others in case of emergency.

GOSHEN, IND.—Since the construction of the electric line between Goshen and Elkhart, Lake Shore and Michigan Southern Railway, passenger traffic between those points has fallen off 70 per cent., the officials of the latter line admit. It has been decided by the Lake Shore road to make a cut in fare in an attempt to bring back the old patrons, and the electric line people insist that they will meet any rate made by the Lake Shore.

CADIZ, OHIO.—There is a movement on foot to build an electric road from Uhrichsville to Cadiz. Meetings have been held along the route, and farmers are giving the right of way and subscribing considerable stock. The capitalists who are pushing the road are enthusiastic over their success thus far, and it is claimed that as soon as it is known the road will be completed there are men ready to continue the road from Cadiz to Martin's Ferry. If this is done there will be a continuous electric line from Wheeling to Cleveland, with the exception of about 25 miles.

NEW YORK, N. Y.—The State Railroad Commission gave hearings at the Fifth Avenue Hotel, in this city, on January 17 on the applications of the Metropolitan Street Railway Company for a change of power on the Seventh Avenue line and parts of the Harlem road. The company desires to dispense with horses and introduce the open-conduit electric system. The proposed change on the Harlem road is upon Thirty-second and Thirty-third Streets, between Third and Lexington Avenues; upon Lexington Avenue, between Thirty-second and Thirty-fourth Streets; upon Thirty-fourth Street, between Lexington Avenue and Second Avenue; upon Transverse Road No. 3, between Eighth Avenue and Fifth Avenue, and upon Eighty-fifth Street, between Central Park and Madison Avenue.

BOSTON, MASS.—There is a well-defined belief in certain quarters that a consolidation of electric railway interests, involving the North Shore Traction Company and various other electrical systems north of Boston, is under way. The extent of the system to be so controlled is practically to be limited only by the coast line of New England from Boston into New Brunswick. At the present time there is a continuous line of electrical railways running from this city to Portland, connecting all the important cities along the coast, with a few breaks, aggregating 25 or 30 miles, and construction on these connecting links is already being arranged. The operation of these lines is at present under the control of many different companies, but the interests back of the consolidation plan are well represented, and an ultimate merging of control will not be a difficult matter of financiering. Contracts are said to have been arranged with construction people for the building of projected lines which will finally connect

every important seaport along the coast, from Boston, through Massachusetts, New Hampshire and Maine to the Canadian border, and it is expected that the work will be completed within the next two years.

PHILADELPHIA, PA.—A new electric road, unique in several respects, has been opened by the Philadelphia & West Chester Traction Company. The road starts at the city line, Sixty-third and Market Streets, and runs on the West Chester turnpike, through the heart of Delaware County, all the way to West Chester. For three years past the road has been in operation to Newtown Square—a distance of 8 miles from the city line—and its completion to the Borough of West Chester, which is about 20 miles from the city line, has just been completed. The initial trip was made on a special car by the officials of the road and a number of guests. The fare between West Chester and the city limits will be 25 cents. It will cost an additional fare to ride into the city on the cars of the Union Traction Company. The road is the longest trolley line running out of the city, and will be the first in the county, so far as known, to use the alternating current. A unique privilege possessed by the company is that given under an old charter to carry freight. The only use which has been made of this privilege, however, has been to carry milk in the early mornings from the farms this side of Newtown Square to the city, the milk wagons meeting the milk car at the city line.

Legal Notes.

ELECTRIC RAILWAYS ON COUNTRY HIGHWAYS AN ADDITIONAL BURDEN.—An electric passenger railroad on a country highway is held, in Zehren v. Milwaukee Electric Railway Company (Wisconsin S. C.), to constitute an additional burden, which requires the consent of the abutting owners and payment of compensation.

CROSSING CAR TRACKS IN PENNSYLVANIA.—Judge Dean, of the Supreme Court of Pennsylvania, reverses a trial court judgment in favor of Blaney v. Electric Traction Company, of Philadelphia, on the ground that plaintiff's husband, who was killed in attempting to cross the company's tracks, did not exercise due care; that he should have looked in both directions before attempting to cross.

THE SPRAGUE ELECTRIC RAILWAY AND MOTOR COMPANY VS. HOOSICK RAILWAY COMPANY.—Judge Coxe, in the United States Circuit Court for the Northern District of New York, on November 11 last, in this case decided that the defendant has infringed patent No. 324,892, issued to Frank J. Sprague, and granted a perpetual injunction against the defendant restraining it from using the apparatus embodying the subject matter of the combination of claims 1—9 of said patent. This patent covers the method of spring support for electric railway motors.

INJUNCTION IN A SUSPENDED SWITCH CASE.—In the case of the Thomson-Houston Electric Company vs. the Railway Electric Light and Power Company, Judge Kirkpatrick, of the United States Circuit Court for the District of New Jersey, on November 7, 1898, enjoined the defendant from using the device described in patent No. 424,695 for "Improvements in suspended switches and traveling contacts for electric railways," issued to Charles J. Van Depoele. The court states that the defendant has infringed upon the 3d, 4th, 11th, 19th, 20th, 23d, 25th, 26th and 27th claims of said patent.

BROOKLYN, N. Y.—The Court of Appeals at Albany handed down a decision on January 10 in the case of Ingersoll v. the Nassau Electric Railroad Company, of this city. Oliver Ingersoll sought to restrain the company from using the tracks of the Atlantic Avenue Railroad Company on Bergen Street, in Brooklyn, on the ground that a constitutional amendment of 1874 made the consent of the abutting property owners a pre-requisite to the operation of a surface railroad on the streets of a city, even though the cars were to run upon the tracks of another company. The court refutes this contention, and holds that the act of 1839, which authorizes one railroad corporation to contract with another for the use of its road, is in full force and effect to-day. The court explains that the question here presented did not appear in the Kingston Colonial City Traction Company's case, and that this is the first time that it has been passed upon by the Court of Appeals.

Personal Notes.

MR. STEPHEN D. FIELD, of Stockbridge, Mass., has gone to Europe on business.

MR. J. F. KEEFE, for ten years traffic manager of the Illinois Steel Company, has resigned his position to accept a similar one with the new American Steel & Wire Company.

MR. S. B. WAY has resigned his position as construction engineer for the Electric Storage Battery Company, of Philadelphia, to accept the position of chief electrician for the Imperial Heat & Light Company, St. Louis, Mo.

MR. ALFRED A. THRESHER, president of the Thresher Electric Company, Dayton, Ohio, was in New York during the week. The Thresher Company has secured a large government order, which causes Mr. Thresher to spend quite a little of his time just now in Washington.

MR. JAMES BURKE, consulting electrical engineer, of New York, has just arrived from Europe. Mr. Burke has been in Berlin, Germany, for several months past as consulting electrical engineer of the Bergmann Elektromoteren and Dynamo-Werke. It is Mr. Burke's intention to return to Berlin.

COLONEL JOHN N. PARTRIDGE, of Brooklyn, who has been appointed by Governor Roosevelt to be Superintendent of Public Works, is well known among street railway men through his former connection with street railway interests in Brooklyn. He was president of the Brooklyn City & Newtown Railway Company from 1886 until September, 1897.

Obituary Notes.

MR. JOEL C. CLARK, treasurer of the New York and Pennsylvania Telephone and Telegraph Company, and secretary of the New York and New Jersey Telephone Company, died at his home in Brooklyn on January 11 at the age of fifty-seven years. Mr. Clark was born in Hallowell, Me. He was an incorporator of the two telephone companies named and a director in each since its organization. His remains were buried in South Framingham, Mass.

MR. M. C. BULLOCK, president of the Bullock Manufacturing Company, of Chicago, died in that city on January 12. Mr. Bullock was born in Granville, Washington County, N. Y., June 26, 1838, and spent the early years of his life on a farm. He became an apprentice in the machinist's trade when he was twenty-four years of age, and had been at work but eighteen months when he was made foreman of a shop employing from thirty-five to forty men. After serving his apprenticeship he traveled about from shop to shop for the purpose of gaining wider experience in his chosen vocation, working in machine shops of all kinds from Massachusetts to Missouri. In 1870 Mr. Bullock was engaged as superintendent of the Pennsylvania Diamond Drill Company. During his

The Late M. C. Bullock.

service with this company he made some important improvements on diamond drills, which were patented, and built up this company's business in a very satisfactory manner. In 1871 he became general superintendent of the American Diamond Drill Company, of New York. He introduced the diamond drill at the Hell Gate submarine excavation in New York Harbor and also introduced it for prospecting purposes in many mines and quarries in the Easteren States. In the fall of 1873 he superintended and built the plant used in driving the Lima and Oroya Railroad tunnel through the Andes Mountains at a height of nearly 14,000 feet above the level of the sea. The failure of the American Diamond Drill Company in 1874 ruined Mr. Bullock financially, but, undaunted, he aided in reorganizing the company as the present American Diamond Rock Boring Company. He resigned his position with this concern in 1875 and went to Chicago, where he engaged in business on his own account. In 1878 he started the business of the Bullock Manufacturing Company. By perseverance success finally came to his undertaking, and a large and prosperous business was built up. The company added to its list of manufactures rock drills, air compressors, hoists, steam engines, etc., beside diamond drills, the latest addition being the Willans high-speed engine. Mr. Bullock had been failing in health for over a year, but his death was unexpected.

Educational Notes.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—A graduates' magazine, "The Technology Review," has just been issued by the recently organized association of class secretaries. It is an octavo volume of 140 pages, attractive in appearance and of the best workmanship.

THE NOVEMBER NUMBER of the University of Tennessee "Record," which is published by the University of Tennessee, at Knoxville, covers a wide range of engineering and scientific subjects. Among the contents are an illustrated description of a convenient form of gas generator, an illustrated description of a new transmission dynamometer and an article on chimney design.

Trade and Industrial Notes.

THE LAKESIDE WORKS, of Hammond, Ind., are installing two 165-hp tandem compound engines, built by the Ball Engine Company, Erie, Pa.

THE CRONIGER CYCLE COMPANY, 36-38 West Second Street, Dayton, Ohio, is going into the electrical construction and supply business, and is in the market for general supplies, lamps, etc.

THE WASHINGTON COAL & COKE COMPANY, Dawson, Pa., issues a calendar, the feature of which is an engraving giving a view of a mill erected by George Washington, on Washington Run, in 1775.

CONSOLIDATION OF GERMAN ELECTRICAL INTERESTS.—On January 1 the electrical department of the firm of Ludw. Loewe & Co., Berlin, Germany, passed into the hands of the Union Elektricitaets-Gesellschaft.

REMOVAL NOTICE.—The Eureka Tempered Copper Company has moved its New York office from 107 Liberty Street to the Washington Life Building, 141 Broadway. The company's patrons will be welcomed at its new quarters.

MESSRS. BAKER & CO., manufacturers of platinum, 121 Liberty Street, New York, are distributing to their patrons a neat memorandum book, having flexible celluloid covers. On both covers the American colors are tastefully arranged.

MR. EDWIN S. BOYER, formerly of Philadelphia, is in charge of the New York office of the American Engine Company, of Bound Brook, N. J. An office in New York became a necessity by reason of the growth of the company's business.

THE PHILLIPS INSULATED WIRE COMPANY, Pawtucket, R. I., is distributing a neat calendar, which will be generally appreciated on account of the clearness of the date figures. The products of the company are enumerated on the card, which is of special and artistic design.

ELECTION OF OFFICERS.—At the annual meeting of the E. G. Bernard Company, Troy, N. Y., which was held at the company's office on January 10, the following named officers were unanimously re-elected: President and treasurer, E. G. Bernard; vice-president, F. L. Stevens; and secretary, H. T. Crissey.

THE BALL ENGINE COMPANY, Erie, Pa., has supplied a 30-hp engine direct-connected to an Elwell-Parker dynamo, which combination has been installed in the new steamer Clarence C. Black, built by the Cleveland Shipbuilding Company, Lorain, Ohio. This plant is said to be a very handsome and compact one.

THE WESTERN ELECTRIC COMPANY, of Chicago and New York, has recently issued Bulletin No. 12 T. B. L., descriptive of a tile bolt and lock, which was described and illustrated in THE ELECTRICAL WORLD of December 17, 1898, and also a screw bracket. The two devices are much in demand. A copy of this bulletin will be mailed upon application.

BOILER PLANT AND COAL-MINING OUTFIT TO BE INSTALLED.—The Reinecke Coal Company, Madisonville, Ky., intends to equip its mines within the next sixty or ninety days with an entirely new boiler plant, consisting of four boilers of 72 inches diameter, with the necessary fittings; also the necessary electrical equipment to haul coal out of the mines and do other mine work.

THE CUTLER-HAMMER MANUFACTURING COMPANY, 70-82 West Jackson Boulevard, Chicago, announces that it has greatly increased its manufacturing facilities, and claims to now have the largest and, it believes, the best equipped factory in the world devoted exclusively to the manufacture of rheostats. With these facilities the company is enabled to offer its products to the trade at lower rates.

THE GLOBE CARBON COMPANY, Ravenna, Ohio, has issued a neat trade sheet showing the great variety of forms of carbons manufactured by it for the electrical trade. All the illustrations are in half-tone, and are arranged in panels around the sheet, which is 16 by 24 inches in size. The goods illustrated are battery carbons of all kinds, diaphragms and black plates, elliptical and round electric light carbons, etc., etc.

THE G. F. BRUNT PORCELAIN WORKS, East Liverpool, Ohio, has issued a very handsome calendar for the new year. There are six sheets, two monthly calendars to a sheet, and on each sheet there is a handsome colored lithograph illustrating the story of "Cupid in Camp" and "Cupid on Deck." The pictures show pretty girls in military and naval uniform, with Cupid nearby, looking on to see that they conduct themselves properly. They make attractive soldiers and sailors.

THE CARBON COMBINE.—In the last issue of THE ELECTRICAL WORLD reference was made to a proposed combination of carbon interests throughout the country. In this connection the United States Carbon Company, Cleveland, Ohio, desires to call the attention of the trade to the fact that it is in no way connected or associated with the combination. It states that it is thoroughly equipped with the largest and most modern and improved machinery in the world, and is prepared to manufacture and supply all varieties of electric light carbons.

MR. WILLIAM ROCHE, 259 Greenwich Street, New York, inventor and sole manufacturer of the "New Standard" dry battery, has added a novelty to his business in the shape of an electric horseshoe scarf-pin mounted with brilliant colored crystals and illuminated with a tiny incandescent lamp. The lamp is operated by a No. 4 vest pocket cell which contains no acid. Mr. Roche says that this novelty is finding much favor in the trade and with the public generally. He reports that the United States Government has just sent him a large additional order for dry cells for use in the navy.

FABIUS HENRION, Nancy, France, has issued two catalogues and price lists of polyphase and alternating-current generators, transformers and arc lamps, for both continuous and alternating current. The generators and transformers are illustrated and briefly described. The operation of the Pilsen arc lamp is also quite fully described in the catalogue devoted to the subject of lamps, and the economy of operation and advantages of the lamp are pointed out. An extensive variety of arc lamps is illustrated, and they show some designs that are quite different in many respects from those produced by American manufacturers.

THE SPRAGUE ELECTRIC COMPANY, 20 Broad Street, New York, has gotten up a vest pocket memorandum book for 1899 which will be of considerable utility to those fortunate enough to obtain a copy. There is a memorandum space for each day in the year, besides a lot of tabulated information such as wiring tables, etc., which will be useful for ready reference. Throughout the pages attention is called to the good points of Lundell motors, interior conduits, Sprague electric elevators and the Sprague multiple-unit system of electric traction. Ample space is also provided for addresses and memoranda. The book is substantially bound in leather.

THE RITTER SOLDERING IRON ATTACHMENT is an example of the value of a very simple device. It is a small soldering iron tip designed to be attached to the burner of an ordinary gasoline blow-torch. It may be attached or removed instantly with an ordinary screwdriver, and is capable of doing all of the work of an ordinary soldering iron. It has the advantage of being light and convenient to carry around and of being always hot and ready for use as long as the torch is burning. The Electric Appliance Company, Chicago, is introducing this specialty, and states that it has no difficulty in selling one or more to every construction man to whom it is shown.

STURTEVANT ELECTRIC FANS.—Bulletin H, issued by the B. F. Sturtevant Company, Boston, Mass., describes and illustrates various types of electric fans. These include the "Monogram" and a long line of special types. These fans are fitted with bipolar motors, both open and enclosed. The company makes a type of fan having an eight-pole circular-frame open-type motor, the fan being designed to be supported immediately beneath the deck on shipboard for ventilation purposes. The motor shaft is supported on tripod hanger bearings. The B. F. Sturtevant Company has also just issued a neat pamphlet giving a long list of users of Sturtevant fans for mechanical draft. It is stated that there are 125,000 Sturtevant blowers in use.

SOUTHERN INDUSTRIAL INTERESTS.—The Christmas number of "Dixie," which is published by the Southern Industrial Publishing Company, Atlanta, Ga., is replete with interesting matter. It contains an epitome of Southern manufacturing during the past year, and is well illustrated. An article by President Henry S. Hartzog, of the Clemson College, of South Carolina, briefly describes and illustrates this institution, which is one of the most prominent of an educational character in the South. Another article describes the Georgia School of Technology. This institution has a department of electrical engineering, and views are given of the dynamo laboratory, the machine shop, etc. The number contains considerable excellent reading on the general industrial progress of the South.

THE DODGE MANUFACTURING COMPANY, of Mishawaka, Ind., manufacturer of the Dodge patent independence wood split pulley, Dodge patent American system of rope driving, and of a general line of up-to-date power-transmitting machinery and grain-handling machinery, has purchased all of the interests and good will of the Rice Machinery Company, located at 166 to 174 South Clinton Street, Chicago, Ill. The Dodge Manufacturing Company will continue to carry on the business at the latter address, and the personnel will be the same as under the Rice Machinery Company, the change being simply in name. The Dodge Manufacturing Company reports excellent business conditions throughout the country. Its various branch stores in New York, Boston, Chicago, etc., are exceedingly busy, and the factory at Mishawaka continues in operation night and day. The increase in trade was felt so greatly that in the latter months of 1898 it was found necessary to add to its already capacious factory a new brick building 300 feet in length by 80 feet in breadth. This building has been well fitted out with all of the latest appliances for handling the trade quickly and economically.

THOMSON RECORDING WATT-METERS.—Ten years ago electrical energy was invariably supplied at a fixed rate per month for each installation without much regard to the amount actually furnished. To-day electric stations in this country supply on a meter basis the electricity they manufacture with resultant advantage to the station economy. Some idea of the extent to which the meter business in this country has grown may be gathered from the fact that not less than 200,000 Thomson recording watt-meters alone have been manufactured and sold by the General Electric Company. The business has grown from small beginnings by the persistent missionary work which has been carried on by this company through both agents and literature. The latest addition to the meter literature issued from the General Electric press is "Thomson Recording Watt-Meters," a handsomely printed and illustrated brochure in a rich cover, dealing with the different types of these recording energy meters, which the General Electric Company manufactures, their uses and their advantages. Each type of meter is clearly described and so illustrated that its construction can readily be understood. Full instructions are given for the care, connection and reading of these meters. The pamphlet should be found in the library of every electric light and power station, and will be sent on application to the Schenectady office of the General Electric Company.

THE FERRACUTE MACHINE COMPANY, Bridgeton, N. J., is one of the pioneer manufacturers of presses, dies and other tools for electrical work. Some years ago, perceiving that there would be a considerable demand for machinery for cutting out armature discs it got up patterns for a series of very heavy double-crank presses for cutting all sizes of discs. The company has increased its line from time to time, and it can now supply presses for cutting the largest discs that are used. It has just shipped a large press to a firm in Bilston, England, for cutting out 50-inch discs; also a large press to the General Electric Company, Schenectady, N. Y., with a hole in the bed 4 feet by 8 feet, for cutting out half circles. The General Electric Company, it is stated, has in use twelve of the Ferracute Company's large double-crank presses and a number of smaller presses. The company reports that it is selling a large number of its armature-notching presses. These are arranged to cut out any number of notches in any diameter of disc, from 4 to 48 inches. Six of these machines have been recently sent to France, and the company has other foreign orders for similar ones. The Ferracute company has recently enlarged its works, and has put in a new engine and other new machinery, and is running full-handed. It has just issued a circular illustrating its presses, and has commenced work on a new catalogue, which will describe and illustrate about 300 different sizes and styles of machines of this class.

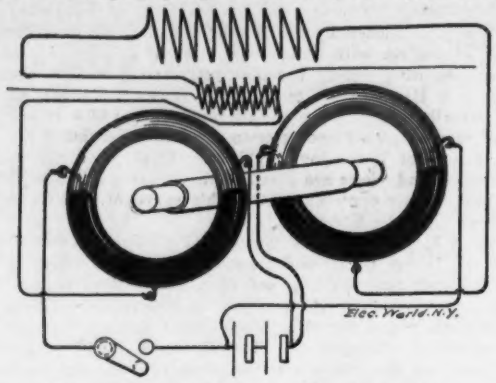
UNITED STATES PATENTS, ISSUED JANUARY 10, 1899.

[In charge of Wm. A. Rosenbaum, 177 Times Building, New York.]

617,314. TELEPHONE; W. E. Byrnes, of Adams, Ind. App. filed May 27, 1897. In a magneto-telephone, a hollow core, a metallic diaphragm secured opposite one of the heads thereof, a metallic bar, constituting a conductor, secured at one end to said diaphragm and adjustably secured at its other end to a stationary part, whereby the tension of said diaphragm may be positively controlled; a helix upon said core in electrical connection with a battery or generator and said diaphragm, and connections between said conductor and the line-wire.

617,325. RAILWAY SIGNAL SYSTEM; F. C. Esmond, of New York, N. Y. App. filed March 17, 1896. A train apparatus consisting of a generator, a contact brush connected to one terminal thereof, two or more additional brushes connected to the opposite terminal thereof, and a brake-magnet having its coils divided into sections, controlled respectively by the said two or more brushes.

617,326. FIRE-ALARM; G. W. Fallin, of Sherman Heights, Tenn. App. filed Jan. 20, 1898. An alarm mechanism comprising a tube containing mercury or other expansible liquid, a float, a rod attached to the float and bearing an electric contact; a second rod slidably mounted in a keeper and having a pointer at one end, co-operating with a scale to set the alarm mechanism for any required temperature; means for securing the rod at an adjusted position, an overhanging spring-arm carried by the adjustable rod and bearing an electric contact in vertical alignment with the first-mentioned contact, and an electric circuit including an alarm and having the aforesaid contacts, constituting its terminals.



No. 617,381.—Electric Transformer.

617,375. ELECTRICAL RESISTANCE; J. F. H. Voigt and J. A. Haeffner, of Bockenheim, Germany. App. filed Dec. 26, 1895. An electrical resistance comprising insulating non-combustible material, and a conducting layer of fired liquid metal, substantially as described.

617,381. ELECTRIC TRANSFORMER; D. H. Wilson, of Chicago, Ill. App. filed July 30, 1897. The combination in an induction coil of a coiled conductor having a metallic core with poles in proximity to each other, a second coiled conductor provided with a metallic core, said second conductor and core mounted between the poles of said first conductor, so as to form part of its magnetic circuit.

617,382. TELEPHONE SYSTEM; D. H. Wilson, of Chicago, Ill. App. filed July 30, 1897. The combination in a telephone system of a transmitter, a receiver, an induction coil comprising two coils, one movably mounted in the magnetic field of the other, and a system of circuits so arranged that the movable coil of the induction coil is responsive to the variations in the current in the other coil when the transmitter is being used.

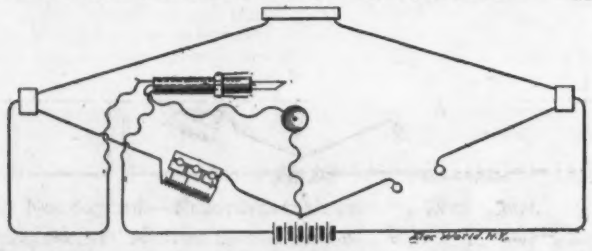
617,418. ELECTRICAL MEASURING INSTRUMENT; G. T. Hanchett and F. B. Sage, of Hackensack, N. J. App. filed May 2, 1898. In a Wheatstone bridge, the combination with the circuits thereof of a bridge circuit-closer and a battery circuit-closer, combined into a single movable device, substantially as described.

617,433. TELEPHONE; T. Berdell, of Summit, N. J. App. filed March 28, 1896. In a telephonic instrument, two diaphragms secured together and supported at their centres, and insulated from each other, in combination with an annulus of granulated material held between the diaphragms, substantially as described.

617,464. LAMP-SOCKET FOR STREET SERVICE; W. E. Holmes, of Newton, Mass. App. filed March 14, 1898. A lamp-socket having a cross-bar with a screw projecting therefrom, a bridge above said cross-bar, and a spring circuit-closer connected to one of said parts and adapted to normally engage the other part.

617,503. CIRCUIT-BREAKER; P. R. Goldey, of Philadelphia, Pa. App. filed March 2, 1898. In a circuit-breaker, the switch-lever in combination with a catch and catch-actuating lever the pivoted lever and hammer head, the lever pivoted on lever, and arranged in connection with the lever as described; an electromagnet carried on the lever and an armature.

617-540. ELECTRICAL SIGNAL; C. A. Parrish, of Jackson, Mich. App. filed Aug. 4, 1897. In electrical signal apparatus, the track instrument, comprising in combination a spring-supported bar arranged in parallel with the track-rail and having its central portion higher and its ends lower than the rail-top, a conducting plate projecting laterally from said bar and insulated therefrom, separated spring-contacts normally engaging the upper side of said conducting plate, and circuit connections to said contacts, whereby the passage of a car-wheel over said bar will break the normally closed circuit between the spring contacts and said conducting plate, substantially as described.



No. 617,418.—Electrical Measuring Instrument.

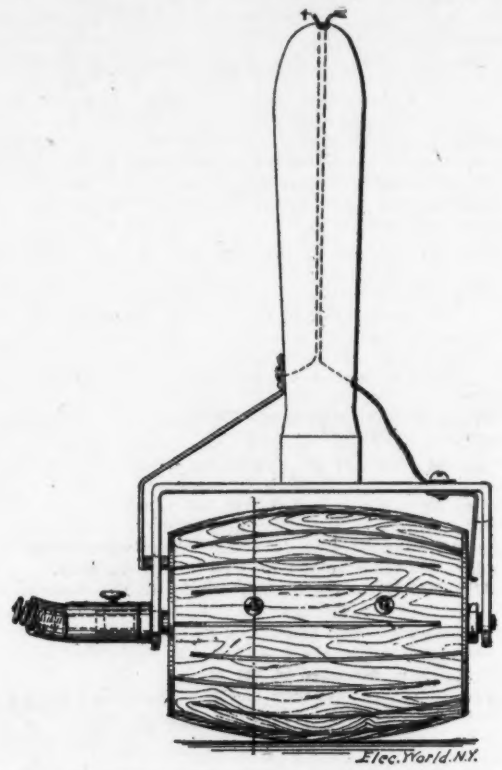
617,543. ELECTRO-THERAPEUTIC AND MASSAGE APPARATUS; O. Schneider, of New York, N. Y. App. filed Aug. 17, 1898. A roller electrode for galvano-faradic massage apparatus, consisting of wooden sections, metallic heads for said sections, and intermediate metallic strips connected alternately with the opposite heads of the roller.

617,546. CONTROLLING ELECTRIC MOTORS AND TRAINS; E. Thomson, of Swampscott, Mass. App. filed Feb. 28, 1898. In an electric controller, the combination, with a plurality of separate contacts, of a common blow-out magnet, energized by the magnets which actuate the contacts.

617,592. ELECTRIC DEVICE; D. Misell, of New York, N. Y. App. filed March 12, 1898. The combination of a tubular casing, a translating device at one end, a battery, the cells of which are arranged end to end in the casing, one pole of the battery formed by the cells being in direct contact with a permanent terminal of the translating device and with a cover for the casing at one end, and suitable means for closing the circuit, substantially as described.

617,598. AUTOMATIC REGULATOR; G. S. Neeley, of Pacific, Mo. App. filed July 28, 1897. In an automatic regualtor, the combination of an induction motor included in the primary circuit of a dynamo, an auxiliary exciting generator for said dynamo, an automatic governor having its rotary parts carried by the rotary member of said induction motor, and a sleeve limited to slidable movements; a triple crank carrying an adjustable weight, and link connections between the triple crank and the governor sleeve and the shiftable brush carrier of the auxiliary generator.

617,601. SYSTEM OF CONTROL FOR ELECTRIC MOTORS AND RAILWAY TRAINS; W. B. Potter, of Schenectady, N. Y. App. filed March 17, 1898. The combination with a shaft of means for actuating it in either direction, a plurality of stops arranged in pairs, one stop of each pair being so arranged as to be in while the other is out, and means for actuating said stops.



No. 617,543.—Electro-therapeutic and Massage Apparatus.

617,608. ELECTRICAL CUT-OUT; A. P Seymour, of Syracuse, N. Y. App. filed Nov. 1, 1897. As a new article of manufacture, an integral porcelain fuse-box for an electric cut-out having perforated ears for the attachment of the line wire, perforated shoulders for the supporting screws and a longitudinal recess for receiving the fuse-carrying plug.

617,621. ELECTRIC HEADLIGHT-LAMP; H. P. Wellman, of Ashland, Ky. App. filed Sept. 15, 1898. An electric headlight-lamp having a pivoted frame attached to its rear wall, said frame having rearward projections, and means for adjusting said frame.

617,691. TELEPHONE SWITCHBOARD; J. W. Overshiner, of Elwood, Ind. App. filed Aug. 4, 1896. The combination with a magnet having a hollow core of a jack mounted to rock in said hollow core, and adapted to receive a switch-pin, a drop hinged in front of said magnet and jack, and contact pins co-operating with said jack.

617,702. ANNUNCIATOR-DROP DEVICE; W. C. Meissner, of Chicago, Ill. App. filed July 1, 1896. An annunciator drop, comprising an electro-magnet, a case therefor stamped from a continuous piece of metal, and comprising a body portion provided with wings and adapted, when bent into shape, to surround the sides and bottom of said magnet; a lug projecting from each side of said body portion, near its end, and integral therewith a projecting part at other end of said body portion integral therewith, and adapted, when bent into shape, to be connected with the core of the magnet and cover the end of said magnet; an armature pivoted to the lugs on said body portion, a drop located at one end of the magnet, and a hook connected with said armature extending past the magnet, so as to engage said drop.